AN ECONOMIC EVALUATION OF HAND-TRACTOR LEASING PROJECT IN INDONESIA : A CASE STUDY IN KABUPATEN BADUNG, GIANYAR, AND TABANAN THE PROVINCE OF BALI

by

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DECLARATION

Except where otherwise indicated, this dissertation is my own work

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ABSTRACT

This study deals with an economic evaluation of a hand-tractor leasing project in Indonesia, with a case study in Kabupaten Badung, Gianyar, and Tabanan, in the province of Bali.

By introducing hand-tractors, it is hoped that the productivity of labour and land will increase, and that therefore total output will also be increased. However, the introduction of hand-tractors sometime causes labour displacement, which can lead to problems of unemployment.

In Java and Bali, from time to time there are indications of shortages of power (human and draft animal) for land preparation, especially at the peak agricultural season and in the irrigated areas; hand tractors could be introduced to alleviate this. Because most farmers are short of funds, the introduction of hand-tractors could be in the form of a leasing project.

The data used in this study was mainly from the previous studies done by the Sub-Directorate of Agricultural Mechanization Department of Agriculture (1976) and the Agro-Economic Survey (1977). Cost-benefit analysis was employed in this study, and the criteria used were net present value (NPV), benefit cost ratio (B/C), and internal rate of return (IRR).

From the financial analysis, under the assumption that the price of a tractor is Rp 1,300,000, that the capacity of tractor per hectare is 20 hours, that the area cultivated per season is 18 hectares, that the rental fee is Rp 19,800 per hectare, and that the operation cost is Rp 9,125 per hectare, the leasing hand-tractors project will be financially profitable from the point of view of tractor owners (assuming that the economic life of the tractor is between 3,500 and 4,000 hours with a salvage value of 10 percent). If the economic life of the tractor is less than 3,500 hours with a 10 percent salvage value, the operation of the hand-tractor leasing project will be financially unprofitable.

From the point of view of tractor renters, the leasing project will be financially attractive if the cultivation cost by tractor is less than the cultivation cost using traditional methods, and if output increases as a result of the increase in the productivity of land.

From the point of view of society as a whole, the introduction of hand-tractors will be economically profitable if the introduction of tractors can increase cropping intensity by at least 13 percent (based on the shadow price of foreign exchange Rp 415 for US $ 1), or by at least 11 percent (based on the shadow price of foreign exchange Rp 625 for US $ 1).

Analysis of the impact of the introduction of hand-tractors on employment potentialities showed that when the "kerta masa" system is implemented, in which the cultivation period is between 15 and 21 days, the introduction of hand tractors will be economically justified. If the "tulak-sumur"

system, in which the cultivation period is between 21 and 75 days, is implemented, then the project becomes unattractive.

The higher cropping intensity, as a result of the introduction of hand-tractors, increases farming activities and it therefore increases the demand for labour; thus the introduction of hand-tractors is likely to create employment opportunities.

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CHAPTER I

INTRODUCTION

1.1.Background

Development can be defined as a dynamic process of change toward a better level of living. This process includes changes in ways of thinking and working. In economic terms, the change process can be divided into changes in supply on the one hand and changes in demand on the other. Changes in supply include the introduction of new resources, accumulation of capital, introduction of new production techniques, and modification of the institutional and production organization (Adiratma 1977,p.1).

The introduction of new production techniques can involve the use of mechanical implements in the agricultural sector, known as agricultural mechanization or mechanization.

The term "mechanization" is somewhat misleading. It conjures up a picture of sophisticated machines increasingly engaged in the replacement of human and animal labour. According to Hall (1973,p.3), mechanization is anything from the improvement of the hoe to the introduction of large power units and equipment depending on time, place, and related conditions. Stout and Downing (1976,p.172) described mechanization as encompassing the rise of hand and animal

operated tools as well as motorized operation, thereby increasing yields, the quality of products, and overall efficiencies. By mechanization, Mosher (1974,p.335) means introducing the use of mechanical procedures which have not previously been used. Included in this process are both machines themselves and the institutional arrangements by which they are available to and used by farmers. The National Symposium on Agricultural Mechanization in Ciawi, West Java (1967) defined the objective of agricultural mechanization as :"Mastery and exploitation of natural resources for the development of human potential in agriculture for the welfare of the society". Furthermore the symposium described the scope of agricultural mechanization: it was seen to cover farm machinery, soil and water conservation techniques, farm buildings, farm electrification, and machinery for food/farm processing.

From the above definition, it is obvious that the meaning and the scope of agricultural mechanization is very wide, and that tractorization or the introduction of tractors or power tillers in agricultural activities is just one part of the scope of agricultural mechanization. The emphasis in this study is on the introduction of hand-tractors or the use of power tillers. For simplicity, the terms agricultural mechanization, mechanization, and tractorization, as well as hand-tractors and power tillers, will be used interchangeably here.

Firstly, it is hoped that agricultural mechanization may increase the productivity of labour. With the help of mechanical tools, the capacity of a labourer will be increased

rapidly depending on the kind and the capacity of the tools. To cultivate one hectare of "sawah" (rice field) by human labour needs more total mandays than is needed when a plough drawn by a pair of bullocks is used, and this in turn needs more mandays than a plough drawn by a tractor (table 1.1.).

TABLE 1.1

TIME REQUIRED FOR LAND PREPARATION BY HUMAN LABOUR, BULLOCK, AND POWER TILLER IN SUBANG, WEST JAVA (1974)

No.	Power Used	Time for land preparation per ha		
		AVMD	AVAD	AVTD
1.	Human + hoe	65	-	-
2.	Bowong[a)] + plough/harrow	67	-	-
3.	A pair of bullocks	22	18	-
4.	Power tiller	4	-	4

Source : Soedjatmiko and Soewardjo (1974)

Notes : a) Bowong : 3-4 persons together pull a plough/harrow, one of them rides on it to steer.

AVMD : average mandays; AVAD : average animal days; and AVTD : average tractor days

1 man-day = 7 hours; 1 animal-day = 5 hours; 1 tractor-day = 7 hours

A study by Alviar (1974,pp 198-210), in Laguna, Philippines indicated that a total of 16 mandays per hectare were saved if a tractor was used instead of water buffalo in land preparation. Mechanization also provides a means for lessening the drudgery of human labour, so labourers can work longer and their productivity and effectiveness are thereby increased (Hall 1973,p.5).

Secondly, agricultural mechanization may increase the productivity of the land by increasing cropping intensity. By using tractors, cultivation can be carried out faster so that the cropping intensity of the irrigated land can be increased. Moreover the risk of drought for the rainfed areas can be decreased because land can be cultivated in time for the rain. In Sidrap, South Sulawesi, during the period 1975 to 1977, the introduction of mini-tractors of 12-15 horse power increased cropping intensity from 14 to 27 percent (Soedjatmiko et al, 1978). An IBRD study (Hamid 1973,p.9) showed that on irrigated farms in the Punjab, cropping intensity increased between 140 and 200 percent after the introduction of mechanical draught-power. The study concluded : "It can be conservatively estimated that from introducing mechanization the cropping intensity is increased by at leased 20 percent in addition to what would be feasible with bullock draught power alone". There are no particular studies on this area in Indonesia, thus the IBRD study can be used as a "standard" to show that the introduction of hand-tractors for land preparation could increase the cropping intensity by at least 20 percent. This "standard" will be used in chapter 4 of this study.

Thirdly, mechanization may increase production. A study by Soedjatmiko (Soedjatmiko et al,1978) in Tajur, West Java, reported that the introduction of power-tillers for land preparation increase the yield by 3-4 quintals of "gabah" (rough rice) per hectare i.e. about 10 percent of the normal yield per hectare. Another study by Mangu (Soedjatmiko et al,1978) in Kabupaten Sidrap, South Sulawesi in 1976-77, using

a high yielding variety (IR-26), concluded that land cultivation by mini-tractors could increase the yield by 6.3 quintals of "gabah" per hectare or abaout 13.6 percent greater than if cultivation was done by traditional methods. In contrast with these studies, Sinaga (1978,pp. 102-111) and Goni (Kompas, 3/9/79) pointed out that tractorization could not increase yield. Alviar (1974,p. 207) calculated that there is a labour productivity difference of 9.4 cavans (1 cavan=44kgs) produce per manday of ploughing and harrowing, which implies that the use of a tractor is more productive than the use of water buffalo in land preaparation. A study in Pakistan by Hamid (1973,pp. 1-12) indicated that in principle a tractor, including its implements, is able to increase production in three ways :

a. Yields of existing crops can be increased through better and more timely land preparation (yield affecting timeliness)

b. The area under crops can be expanded since tractors provide the power (which can even be used during the night) for growing a second crop in the same year on the same field where sufficient water for a second crop is available (cropping intensity affecting timeliness).

c. The area under fodder (to feed the bullocks) can be released for cultivation of cash crops.

Then Hamid summarized the effects of mechanical cultivation on output as shown in table 1.2.

TABLE 1.2

THE EFFECTS OF MECHANICAL CULTIVATION ON ANNUAL OUTPUT IN 1973

(percent)

	Likely increase in output	
	Average	Range
a. Yields	25	20 - 30
b. Intensity	30	20 - 40
c. Released from fodder	20	20 - 20[a)]
Total	75	60 - 90

a) No variation

Source : Hamid (1973, p.9)

The evidence on the magnitude of yield increases resulting from the use of tractors is conflicting. Rao (1973) is convinced that tractorization leads to a substantial increase in yield per acre, based on his study of the Ferozepore district in 1968-1969. Vashista (1972) argues on the basis of data from the same district for the same period: "We do not find any evidence in support [of the] hypothesis that mechanization leads to higher employment and output per acre". For the purpose of this study, since it is still uncertain as to whether the use of tractors increases yield per unit area or not, it will be assumed that the use of hand tractors for land preparation does not increase the yield per hectare per season. It is suggested, however, in terms of cropping intensity, that the productivity of land per hectare per year will increase as a result of the use of hand-tractors. According to the IBRD

study as mentioned above, the productivity of land will increase by at least 20 percent.

The increase of labour productivity sometimes causes labour displacement, which causes problems particularly in a labour surplus country like Indonesia. According to Sinaga (1978,p.104), the introduction of one tractor (12.5 HP) in regular use displaces 2,210 mandays of human labour per year if replacing cultivation by hoe, or 650 mandays per year if replacing land cultivation by a combination of plough and hoe. Bartsch et al (1978,p.152) indicated that the substitution of draft animals for human labour in land preparation and for transportation reduces the total labour requirement by 19 percent or 1,390 manhours. This situation is a constraint on the economic development program of the Indonesian Government, since the objectives of its economic development program are : (a) increasing growth of output, (b) increasing employment creation, and (c) improving income distribution.

Though Indonesia is known as a labour surplus country, particularly in Java and Bali, it is suggested that in some regions of Java and Bali there are indications of a shortage of human labour and draft animals for land preparation, particularly at the peak season and especially in the large irrigated areas such as Karawang, Subang, and Indramayu in West Java. A shortage of labour exists in these areas, particularly for tilling the land prior to planting the dry season rice crop, because the land preparation has to be done quickly but labourers are still busy with harvesting the rainy season crop in the area. As a result, no land tillage is done for the second crop and planting is delayed because of lack of human

labour and draft animals, so consequently the harvest fails.

A study by ESCAP (Rijk 1979,p.10) reported that the shortage of labour was increased because formerly more seasonal labourers would migrate from Indramayu and Central Java to Karawang, but since the irrigated area had recently increased in Indramayu and Central Java, labour migration to other areas had decreased. It was also reported that in Karawang and surrounding areas, young labourers migrated to Jakarta causing shortages of agricultural workers. Information from a cooperative member in the Bandung valley mentioned that there was a shortage of manpower to till the land because labourers preferred to work in the textile industry and young man especially did not like to work in the "sawah" anymore. To alleviate the problem of the shortage of human labour and draft animals for land preparation, hand-tractors or power-tillers were introduced in some parts of Java. Since most farmers are short of funds for buying tractors, the introduction of hand-tractors is in the form of a leasing project (1). An empirical study in Neuva Ejica, the Philippines concluded that farmers place a high value on easing the work load, particularly between the first and the second crops, as the usual reason for using tractors for land preparation (Batista and Wickham 1979,p.6).

This study deals with an economic evaluation of a hand-tractor leasing project in Indonesia, with a case study in Kabupaten Badung, Gianyar, and Tabanan, the Province of Bali.

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(1) A leasing project is a system in which a leasing company (state,private, or joint) leases or hires the capital equipment (hand-tractor) to the customer (lessee).

1.2. Objectives

The objective of this study is to analyse :

a. whether the operation of the hand-tractor leasing project in Kabupaten Badung, Gianyar, and Tabanan will be profitable from the point of view of the tractor owner, tractor renter, and the society as a whole,

b. the impact of the project on employment potentialities in the Kabupatens whether the introduction of hand-tractor causes labour displacement or creates employment.

1.3. Methodology

Cost-benefit analysis will be used to analyse the operation of the hand-tractor leasing project in Kabupaten Badung, Gianyar, and Tabanan, Bali.

The technique of cost-benefit analysis, involving comparisons of discounted cash flows, is the main analytical tool employed. Another aspect of the study is shadow pricing of the benefits and costs component of the project.

Cost-benefit analysis is the enumeration and evaluation of all relevant benefits and costs to determine whether the net benefits are at least as great as those obtainable from marginal investment opportunities. It involves choice which implies maximization of the present value of all benefits less all costs, subject to any specific constraints. This approach can be used for public and private sector projects, with differences in application depending on the viewpoint to be taken.

The net present value (NPV), benefit-cost ratio (B/C ratio), and internal rate of return (IRR) are criteria which will be used in the analysis.

1.4. The Data

The data used in this study are taken mainly from the previous studies by the Sub-Directorate of Agricultural Mechanization Department of Agriculture (Soedjatmiko et al,1976) entitled : "Feasibilty study pengembangan traktor pertanian di Kabupaten Badung, Gianyar, dan Tabanan Propinsi Bali" (Feasibilty Study of Agricultural Tractor Development in Kabupaten Badung, Gianyar, and Tabanan the Province of Bali), and by team Survey of Rural Dynamic Studies of the Agro Economic Survey (Sinaga et al,1977) entitled : "Feasibilitas Ekonomi Proyek Leasing Hand-Tractor dan Impak Potensiilnya Terhadap Kesempatan Kerja di Kabupaten Badung, Gianyar, dan Tabanan Bali" (Economic Viability of Hand-tractor Leasing Project and Potential Employment Impact in Kabupaten Badung, Gianyar, and Tabanan Bali). Since the writer did not have the opportunity to collect the necessary data for this study, from the start he was aware that the limitations and in accuracy of the data were the major obstacles facing the analysis. However, from the data available, it seems that cost-benefit analysis can be satisfactorily employed to achieve the objectives of this study.

1.5. General description of the study area

Bali is the smallest province in Indonesia (Fig. 1.1. and 1.2.). Its 5,620 square kilometers represent only 0.3 percent of the Indonesian teritory. It is divided into eight "Kabupaten" (regions), three of these are Kabupaten Badung, Gianyar, and Tabanan. According to the Population Census 1971, the total population of Bali was 2,210 million and about 90 percent were living in the rural area, compared to a total population in 1976 of 2.3 millions. This means that during a five year period the population increased by about 8.5 percent or 1.7 percent annually: the population growth and density in Kabupaten Badung, Gianyar, and Tabanan and the Province of Bali during the period 1971 - 1976 is shown in table 1.3.

TABLE 1.3.

POPULATION GROWTH AND DENSITY IN KABUPATEN BADUNG, GIANYAR, AND TABANAN 1971 - 1976

Kabupaten and Province	Population ('000)		Growth Rate (%)	Density		Increase Density (%)
	1971	1976		1971	1976	
Badung	400	436	9.0	769	838	9.0
Gianyar	271	294	8.5	772	837	8.4
Tabanan	328	350	6.7	382	408	6.8
Others	1,121	1,220	8.8	na	na	na
Bali	2,120	2,300	8.5	385	418	8.6

Note : na : not available

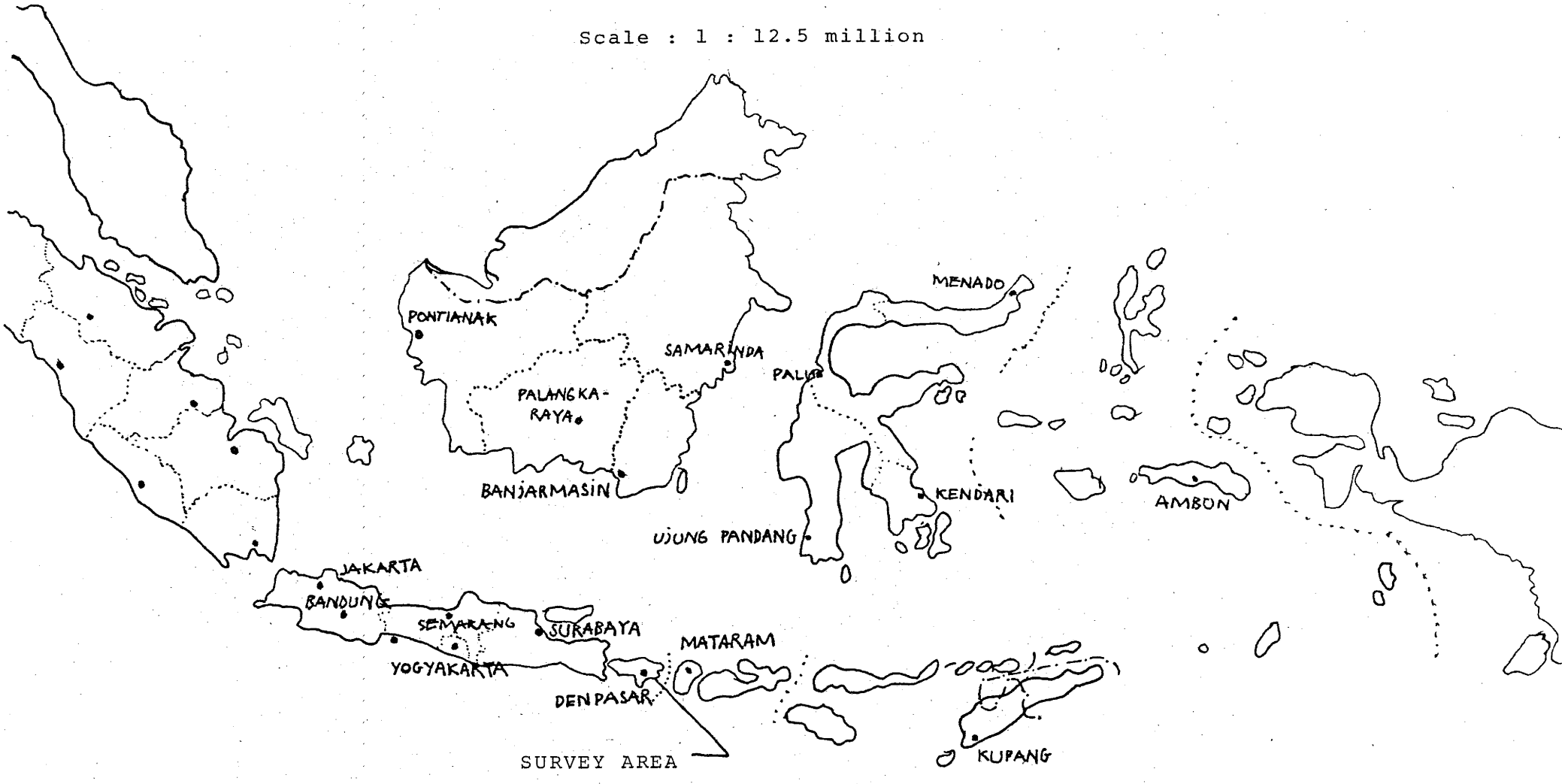
Source : 1971, CBS, Population Census 1971

1976, Kantor Sensus dan Statistik Propinsi Bali (cited in Sukarsa dan Bendesa, 1980).

FIGURE 1.1.

MAP OF INDONESIA

Scale : 1 : 12.5 million



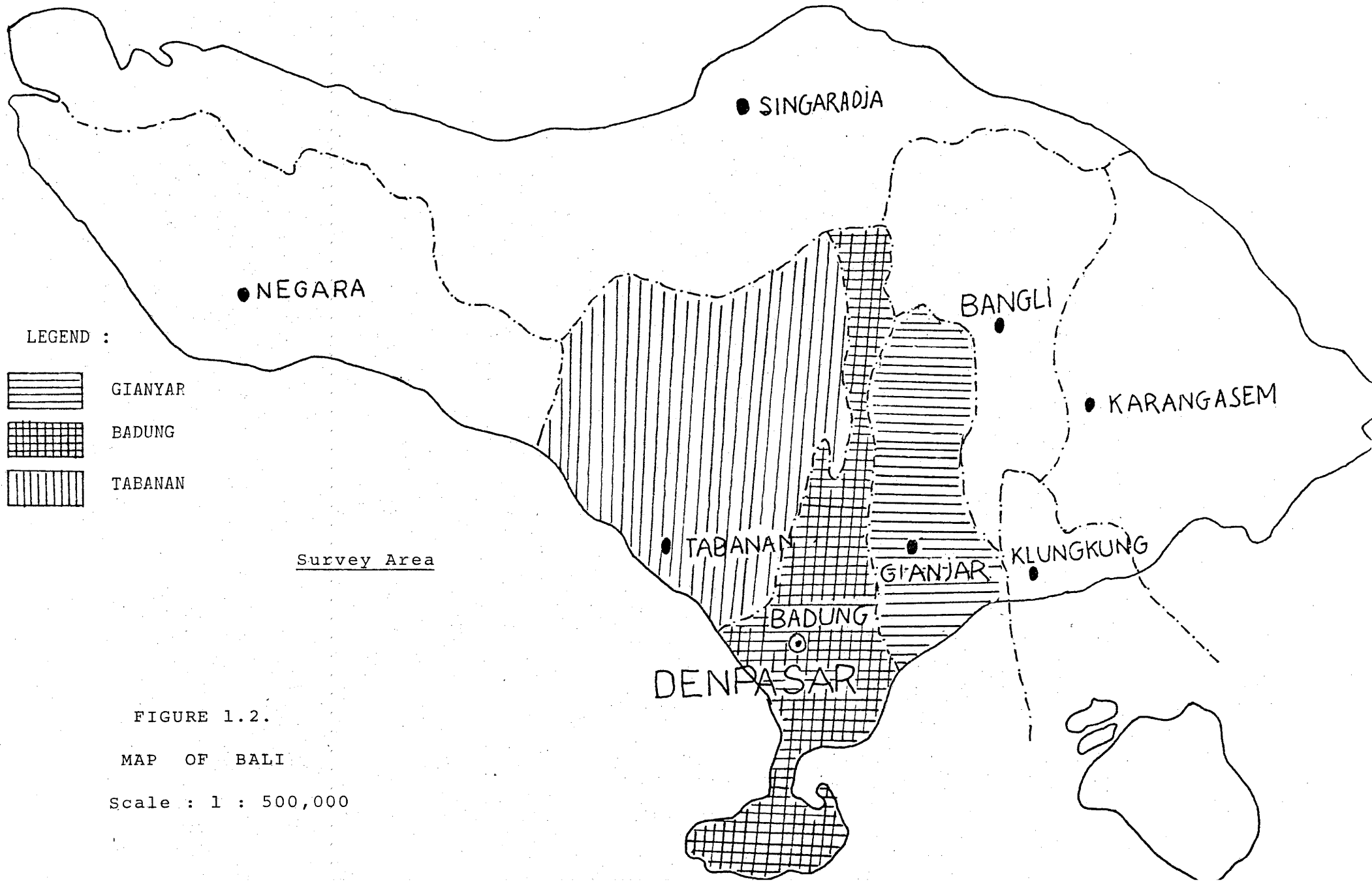


FIGURE 1.2.

MAP OF BALI

Scale : 1 : 500,000

From table 1.3. above, it is obvious that the population density in Kabupaten Badung, and Gianyar, are double the average density of Bali. This may be because most of the tourist attractions in Bali are situated in these Kabupatens. The average size of farm holding in Bali (1973) is about 0.3 hectare of wet land, and 0.47 hectare of dry land per household. The average size of land holdings per household in the study area is shown in table 1.4.

TABLE 1.4.

AVERAGE SIZE OF LAND HOLDING PER HOUSEHOLD IN KABUPATEN BADUNG, GIANYAR, AND TABANAN IN 1973

Kabupaten	Wet land (ha)	Dry land (ha)	Total (ha)
Badung	0.47	0.31	0.78
Gianyar	0.51	0.17	0.68
Tabanan	0.49	0.37	0.86
Others	na	na	na
Bali	0.30	0.47	0.77

Note : na : not available

Source : Soedjatmiko et al (1976)

The average size of land holding per household in Kabupaten Badung, Gianyar, and Tabanan for "sawah" is higher than the average land holding in Bali. On the other hand the average size of holding for dry land in Kabupaten Badung, Gianyar, and Tabanan is lower than in Bali. The land use pattern is shown in table 1.5.

TABLE 1.5.

LAND USED PATTERN IN BALI, AROUND 1950, 1970, and 1977

Land use	1950		1970		1977	
	Km^2	%	Km^2	%	Km^2	%
Sawah (wet land)	964	17	745	13	1,005	18
Dry land agric.&annual crop	1,783	32	1,522	27	1,078	30.5
Estate	891	15	1,284	24	1,050	19
Forest	1,237	23	810	14	1,127	20
Grass land	73	-	-	-	-	-
Non-agric. land	-	-	720	13	352	6.5
Non-prod. land	-	-	368	7	301	5.7
Lakes, ponds and others	672	11	33	-	47	0.8
Total	5,620	100	5,484	100	1,590	100

Sources:

1950 : Monografi Bali, I Gusti Gde Rake, Pusat Djawatan Pertanian Rakjat Djakarta,1954, p.10 (cited in Daroesman, 1973)

1970 : Laporan penelitian tentang strategi pembangunan Daerah untuk Propinsi Bali (cited in Daroesman, ibid)

1976 : Sukarsa and Bendesa (1980), forthcoming.

From the figures it is clear that the total area for "sawah" and dry land declined during a twenty-year period (that is from 1950 to 1970)and then for "sawah" the total area was increased in 1976. However, the area of dry land still declined. The reduction in the area of land under "sawah" may be caused by the encroachment of urban areas, extension of village land needed for housing, and volcanic eruption (Daroesman 1973,p.34). Sukarsa and Bendesa (1980) reported that in 1976 the "sawah" area increased to 1,012 square

kilometers, based on the data from Directorate Land Use. However, according to "IPEDA" (land tax) office, the area of "sawah" is only 974 square kilometers. This difference is due to the different methods of measurement. Nevertheless, whatever the precise figure, there has been a substantial increase which is due to the result of the "sawah" having been covered by volcanic ash; and so it can be cultivated again.

Based on current prices, the income per capita in Bali has risen from Rp 15,713 ($38) in 1969 to Rp 74,680 ($ 180) in 1976, or based on constant prices the increase is from Rp 29,648 ($ 71) to Rp 44,023 ($ 106). The population during this period rose from 2.056 to 2.300 million (table 1.6.).

TABLE 1.6.

INCOME PER CAPITA IN BALI 1969-1976

Year	Population persons ('000) a)	Income per capita b)			
		Current price		Constant price	
		Rp	$	Rp	$
1969	2,056	15,713	38	29,648	71
1970	2,093	19,183	46	31,615	76
1971	2,120	20,646	50	35,793	86
1972	2,158	24,210	58	38,082	92
1973	2,197	38,635	93	38,635	93
1974	2,237	53,956	130	43,375	105
1975	2,277	59,333	143	42,758	103
1976	2,300	74,680	180	44,023	106

Note : US $ 1 = Rp 415
Sources: a) Kantor Sensus dan Statistik Bali (cited in Daroesman ibid)
b) Sukarsa and Bendesa (1980, ibid)

The gross domestic product of Bali in 1971 based on the constant price (1973) was approximately Rp 76 billion of which 50 billion was contributed by the agricultural sector and constituted 66 percent of the total GDP of Bali. In 1976, the GDP increased to Rp 102 billion. However, in terms of percentage, the contribution of the agricultural sector declined to 53 percent, though overall it still increased to about Rp 54 billion. The distribution of Regional GDP of Bali can be observed from table 1.7.

TABLE 1.7.

GROSS REGIONAL DOMESTIC PRODUCT OF BALI

(1973 CONSTANT PRICES)

No.	Industry	1971 Rp m	1971 %	1976 Rp m	1976 %
1.	Agriculture	49,980	66	53,648	53
2.	Industry, construction, water & electricity	6,521	8	16,536	16
3.	Transportation	4,039	5	7,712	8
4.	Trade	5,631	7	7,557	7
5.	Finance & service	9,771	13	16,593	16
	Total	75,942	100	102,046	100

Sources: Kelompok Pendapatan Regional Indonesia, Perhitungan Pendapatan Regional di Indonesia, 1968-1976, Jakarta, 1978, and Biro Pasat Statistik, Statistical Pocket-book 1977/78, Jakarta 1979, cited in Sukarsa and Bendesa (1980).

Comparing the regional gross domestic product in 1971 and 1976, although the percentage of contribution of the agricultural sector declined from 1971 to 1976, the agricultural sector is still dominant in Bali. It is suggested that this decrease is due to an increase in the contribution of other sectors such as industry, construction, and transportation; all of these are related to the promotion of tourism.

Rice production in Bali since 1961 has increased, except in 1975 when there was a long drought period in 1974 and the explosion of "wereng" disease. The average rice production per hectare (one of the growth indicators of farming) is shown in table 1.8.

TABLE 1.8.

AVERAGE RICE PRODUCTION PER HECTARE IN BALI

(1957 - 1973)

Year	Average yield/ha(ton)	ΔY(ield) in percent
1957	3.7	0
1961	3.3.	-10.8
1965	3.4	3.0
1969	4.0	17.6
1973	4.8	20.0

Source : Soedjatmiko et al (1976)

It is obvious from the figures that since 1961 the average yield per hectare has been increasing, an increase of 17.6 percent during the period of 1965 - 1969; this increase is due to the introduction of the "Bimas" (mass guidance)

intensification program, which was started in 1966/67; since then the intensificatiion program has been adopted and the farmers are familiar with new technological inputs such as high yielding varieties of seed, fertilizer, and chemicals, as well as cultivation techniques.

Compared to potential consumption, rice production in Bali always shows a surplus (table 1.9.).

TABLE 1.9.

COMPARISON OF RICE PRODUCTION AND CONSUMPTION IN BALI

1973 - 1976

('000 ton)

Year	Production 1)	Consumption 2)	Surplus
1973	332	247	85
1974	382	268	114
1975	316	273	43
1976	331	276	55

Source :

1) I Ketut Suardika (1979, cited in Sukarsa and Bendesa, opcit)

2) Calculation based on the food consumption target, i.e. 120 kg of rice per capita per year

Though production decreased in 1975 as a result of the long drought period and the explosion of plant disease (particularly "wereng"), it still showed a surplus compared to the potential consumption.

Inputs such as fertilizer, high yielding varieties and insecticedes have been intensively used in Bali. They have been proved effective by the results of the National Competition of Intensification for rice production during the rainy season 1979. The winner was "kelompok tani" (a group of farmers) Rajasa from Tabanan Bali, with an average production of 9.9 ton per hectare (Kompas, 14/1/80).

Total area of the rice intensification project during "Pelita I" (First Five Year Plan) 1969 -1974 is shown in table 1.10.

TABLE 1.10

TOTAL AREA OF RICE INTENSIFICATION PROJECT IN BALI

1969 - 1974

Year	Total area ('000 ha)	Percentage of total acreage
1969	25	18
1970	38	26
1971	51	32
1972	83	58
1973	93	57
1974	118	72

Source : Soedjatmiko et al (1976)

From the figures, it is obvious that the total area of the rice intensification ("Bimas" and "Inmas"program) has steadily increased since 1969. The situation in the area study in 1974 is shown in table 1.11.

TABLE 1.11.

AREA OF RICE INTENSIFICATION IN KABUPATEN BADUNG, GIANYAR, AND TABANAN, THE PROVINCE OF BALI IN 1974

Kabupaten	Area ('000 ha)	Percentage of total acreage
Badung	18	67
Gianyar	17	57
Tabanan	38	84
Others	na	na
Bali	112	72

Note : na ; not available

Source : Soedjatmiko et al (1976)

The total intensification area in the study area covered about 66 percent of the total intensification area in Bali in 1974.

One agrotechnique constraint of agricultural development in Bali, in addition to the long drought period which comes periodically, is the explosion of pests, insects and disease. Recently the most dangerous is "wereng". In order to reduce this obstacle, the government advised that the "kerta masa" (2)

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(2) "Kerta masa" is a rice cultivation system in which all farming activities are done simultaneously for "sawah" under the "subak".

system of rice production should be implemented. This system features the simultaneous harvesting, planting and cultivation of rice, coordinated by the "subak" (3). Cultivation, plantation, and harvesting are done at the same time, as scheduled by the "subak" leader, for the "sawahs" under the subak. It is suggested that in order to implement this system, the problem of lack of human labour and draft animals will have to be overcome. To alleviate the problem of shortage of human labour and draft animals, hand-tractors are introduced in Kabupaten Badung, Gianyar, and Tabanan, and since most of the farmers are short of capital, the introduction of the hand-tractor is in the form of a leasing project.

1.6. Organization of the study

An introduction which covers the background, objectives, methodology, data, and general discription of the study area has been presented in this chapter.

Chapter 2 presents a discussion of the analytical framework. The financial cost-benefit analysis and the economic or social evaluation are discussed in chapter 3 and 4 respectively.

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(3) "Subak" is a Balinese farmers organization, formed particularly for irrigation and the farming activities, whose members are farmers who "sawahs" lie on the same irrigation channel.

Chapter 5, the last chapter, will summarise the analysis and conclude the study, as well as suggest further research.

CHAPTER 2

THE ANALYTICAL FRAMEWORK

Any project analysis must consider two complementary, but distinct aspects, the economic and the financial. For any project, we are interested in the first instance in the total return, or profitability to the whole society or economy, of all resources committed to the project regardless of who in the society contributes them, and regardless of who in the society receives the benefits. This is the social or economic return to the project and we determine it by applying what we will term 'economic analysis'.

In contrast, each of the individual financial entities which participates in a project (farmers, businessmen, entrepreneurs, private corporations, and public agencies) is properly concerned about the return to the equity capital which it contributes. We may consider this the financial return to any equity participation in a project, and we determine it through what we term 'financial analysis' or 'private return' (Gittinger 1972,pp.4-5).

2.1. Cost-benefit analysis

As mentioned earlier, cost-benefit analysis will be employed in this study. Cost-benefit analysis is a way of setting out the factors which need to be taken into account in

making certain economic choices. It has long been considered as the most practical way of assessing long-term investment projects (Prest and Turvey 1965,p.683). It takes into consideration the timing of cash flows,whereby it is recognized that an amount received or spent now is worth more than the same amount received or spent at some time in the future.

The net present value of benefit (NPV), the benefit cost ratio (B/C ratio), and the internal rate of return (IRR) criteria will be used in the analysis. If,

K = the capital outlay associated with the project;

b1, b2, ...,bn = the cash receipt or benefits expected to be generated by the project at the end of years 1,2,...n;

c1,c2, ...,cn = series of prospectives costs or cash payments projected to occur at the end of year 1,2, ...n;

n = the number of years; and

i = the appropriate discount rate

a. Net present value of benefits :

$$NPV = -K + \frac{b1 - c1}{(1 + i)} + \frac{b2 - c2}{(1 + i)^2} + \ldots\ldots + \frac{bn - cn}{(1 + i)^n}$$

Select project where NPV is greater than 0.

b. Benefit/cost ratio :

$$B/C = \frac{\frac{b1}{(1+i)} + \frac{b2}{(1+i)^2} + \ldots + \frac{bn}{(1+i)^n}}{K + \frac{c1}{(1+i)} + \frac{c2}{(1+i)^2} + \ldots + \frac{cn}{(1+i)^n}}$$

Select project where B/C exceeds 1

c. Internal rate of return is that discount rate which when applied to the flow of net benefit is such that the NPV = 0. In finding the internal rate of return, interpolation is usually resorted to. This procedure is also applied in this study. The rule for interpolating the value of the internal rate of return lying between discount rates too high on the one side and too low on the other is :

$$IRR = \text{lower discount rate} + \text{difference between the discount rate} \times \frac{\text{present worth of cash flow at the lower discount rate}}{\text{absolute difference between the present worths of cash flow at the two discount rate}}$$

the absolute difference is the sum of the two values ignoring the sign which is attached to them. It is better not to try to interpolate between a spread wider than about five percentage

points. It is also better to select a project where IRR exceeds a chosen discount rate (Gittinger 1972,p.80).

The NPV, B/C ratio, and IRR can be computed based on different points of view, and indicate whether or not a project could be undertaken. Thus, the more the NPV exceeds 0, or B/C ratio exceeds 1, applying an appropriate discount rate, the more feasible the project becomes in the sense of financial analysis. Similarly, the greater the IRR compared to that of the standard of discounting rate set by the evaluator, the more acceptable the project becomes.

2.1.1. Choice of discount rate

The technique of cost-benefit analysis involving comparisons of discounted cash flow is critically dependent on the discount rate used. Different rates can change not only the size of the present value, but can make a positive value turn to negative.

Economist are not in full agreement as to the discount rate to be used in order to relate future benefits and costs to their present value. Little and Mirrlees think that most developing countries ought to use a rate around 10 percent in real terms i.e. after inflation, some countries might use even 15 percent (Baldwin 1972, cited in Yalong 1976,p.42).

According to Gittinger (1972,pp.90-91), a discount rate of 12 percent seems to be a popular choice and almost all countries seem to think it lies between 8 percent and 15 percent. He also suggests that the discount rate attached to future returns by society as a whole should be different from

that which the individual would see. Normally, it is felt that the society has a longer time horizon, so that its discount rate would be lower. This suggests that a different (generally lower) rate of interest should be used for public projects than for private projects, giving rise to some awkward allocation problems both in theory and in application. He suggests that financial rates of interest such as the government borrowing rate or the prime lending rate are almost always too low to justify their use in economic analysis.

Rajino (1973,p.67), in his study of Economic Analysis of Replanting Tea Estates in West Java, Indonesia, used a 12 percent discount rate. According to him, this is similar to the lending interest of World Bank loans approved under an international aid scheme to Indonesia.

The interest rate required by "Bank Indonesia" (Indonesian Central Bank) for various loans, effective since January 1978, is 9 to 21 percent per annum depending on the purpose for which the loan is required. For investment credits, an interest rate of 12 percent is levied, this interest rate includes a commitment fee to be paid at the conclusion of the credit agreement and every time upon renewal (B.I., Report for the financial year 1977/78). Both Sub-Directorate of Agricultural Mechanization (1976) and Agro-Economic Survey (1977)used a 12 percent discount rate in their financial analysis. Their data will mainly be employed for this study, however, the Agro-Economic Survey argues that this discount rate is too low compared to other sources of credit (private) which generally is in the range of 2 to 5 percent monthly.

Based on all of these considerations, 12 percent discount rate will also be used in this study. To examine the effect of the interest rate on the project's profitability, a sensitivity analysis will be carried out at discount rate of 2 percent monthly or 24 percent annually.

2.1.2. The economic life of a project

Related to the discount rate to be employed in this study is the length of the project period. The general rule is to choose a period of time which will be roughly comparable to the economic life of the project. Where the project involves a fairly sizable initial capital investment, such as tubewell or an orchard, a convenient starting point for establishing the period of the analysis is the technical life of the major investment item. In some projects, however, although the technical life of the major project investment is quite long, the economic life is expected to be much shorter because of obsolescence (Gittinger 1972,p.87).

Since the emphasis of this study is on the use of hand-tractors, the decision on the economic life of the tractor becomes important in relation to the calculation of depreciation of the tractor. In accordance with Yang (1965,pp.210-211), under normal working conditions, and with the proper care and repairs, a machine loses its usefulness for two reasons: (a) obsolescence, and (b) wear and tear. With the passage of time, a machine may lose its value gradually and become obsolete through the introduction of new and better machines and through technological changes. Hence a machine is expected to possess a life of a certain number of years,

regardless of how much it is used.

On the other hand, a machine may lose its value through wear and tear in actual use. The more it is used each year, the shorter is its life in actual years. In this manner, the life of a machine instead of being reckoned in number of years should be measured in the number of work units. Information on the estimated life of farm machinery in terms of both years and work units may be obtained from an agricultural experiment station and also from reputable manufacturers in countries where farm machinery has been extensively used.

A study by ESCAP (Rijk 1979,p.103) reported that technical developments might also make older machines inferior to the new ones, but this is often not applicable in less developed countries such as Indonesia. In less developed countries many conditions limit the life of machinery to a shorter period than in developed countries, such as insufficient maintenance due to a lack of knowledge and facilities, unskilled operators, climate and field conditions. In contrast, there are also conditions which tend to extend the useful life of machinery; lack of capital to purchase new machines and low wages are reasons for continuing the operation and repair of machines beyond the time period valid under similar working condition in developed countries. Theoretically, the operational life of machinery is unlimited, provided that spare parts are available. However, there is a point where investment in new machinery is cheaper than repairing old ones.

As mentioned earlier, the decision on the economic life of a tractor becomes important in relation to the calculation of the depreciation cost. When a tractor becomes too old for practical use, it may still possess a scrap-value/salvage value or trade-in value. Hence, the total amount to be depreciated is the difference between the total money paid for the tractor and the salvage value.

There is no specific method for determining the economic life of a tractor, generally the determination is based on past performance or experience. Jegatheesan (1972,p.391) in his study on the Contribution of Economic Research to Rice Mechanizatiion in West Malaysia with specific reference to the Muda Irrigation Scheme, estimated the economic life of a hand tractor as being 6 years, a 60 BHP four-wheel tractor as 10 years, and a 70 BHP four-wheel tractor as 10 years. Under the Indonesian conditions of poor repair and maintenance facilities and unskilled operators, the average life expectation of tractors is as shown in table 2.1.

TABLE 2.1.

LIFE EXPECTATION OF TRACTORS UNDER INDONESIA CONDITIONS

Type of tractor	Useful life (hours)
1. Hand-tractor (good quality)	4,000
2. Power-tiller (incl.rotary cultivator)	3,500
3. Mini-tractor (incl.rotary cultivator)	3,000
4. 30 - 70 HP tractor (four-wheel)	5,000

Source : Rijk (1979,p.104)

It seems more realistic to determine the economic life of tractors in terms of hours rather than in term of years, since the working hours of the tractor per annum is not known. However, if the working hours of tractors per year is known, the economic life of tractors could be converted into years instead of hours.

Often at the end of a project, there is expected to be some salvage value, that is the capital asset will not have been all used up in the course of the project period and there will be 'residual assets'. The way to cope with this is to treat the salvage value of any capital item (say machinery) as a 'benefit' received by the project during the last year of the project analysis period (Gittinger 1972,p. 106). In order to estimate the salvage value of farm machinery after depreciation, by using the straight line depreciation method, there is a rule of thumb that the estimated salvage value is around 5 to 15 percent of the purchase price (Herbst 1970,p.169). Pased on these considerations, for the purpose of this study, the economic life of a hand-tractor will be estimated as between 3,500 - 4,000 hours, and depending on the working hours per year the economic life of a hand-tractor in terms of year could be estimated as well. The salvage value of the hand-tractor after depreciation will be assumed to be 10 percent of the purchase price, if the tractor has been used during its economic life (3,500 - 4,000 hours), if the tractor is used under its economic life (less than 3,500 hours), consequently the salvage value of the tractor must be higher than 10 percent of its purchase price.

2.1.3. Derivation of cash flow

The derivation of cash flow of a project is seen as earning a flow of gross benefits from which must be deducted the capital investment and paid to the other input costs - machinery, fertilizer, pesticides, labour, management, consultants, and the like. What is left over is residual (which might be negative in the early years of the project) and which is available (1) to recover the investment made in the project, the return of capital; and (2) to compensate for the use of money involved in the project, the return to capital (or on capital). This residual is termed the cash flow (Gittinger 1972,p.66).

Specifically, from both the point of view of the owner and renter of the tractor involved in a financial analysis, and from the point of view of the society as a whole, to compute the cash flow, any allowance for depreciation of capital cost is not deducted from the gross returns. From the individual point of view, the cost of production factors and the value of output are based on market prices. All costs involved are considered as costs to the individual investor. Taxes that must be paid (income taxes, sales taxes, custom duties etc) are included as costs too.

In financial analysis, outside capital borrowed by the entity which is undertaking the project -whether the entity be a farmer, an individual businessmen, or shareholders of a corporations taken as a group- is (normally) entered into the receipts stream as a kind of benefit received. Then, when a payment of interest or repayment of principal is made to

outside suppliers of capital, it is deducted from the gross return as a cost in deriving the cash flow.

From the social viewpoint, costs of production factors may not reflect their real cost to the economy due to market price distortion occurring in less developed countries like Indonesia. According to Warr (1977,p.150), these distortions arise in part from the failure of the markets themselves to function efficiently and in part from the effects of government policy, but their implications are that market prices are potentially misleading indicators of social valuation. Thus, some prices may be shadow priced. In economic analysis, income taxes, sales taxes, and other taxes, and customs duties on imported goods are considered as a transfer of payment within society, not payments for resources used in production. Hence, taxes and duties are not deducted from the benefit stream when deriving the cash flow as the basis on which to compute the productivity of capital. To the whole economy, taxes are a benefit available to repay society for the use of its capital invested in the project and may be used for whatever purposes the society decides is best.

In economic analysis, a distinction must be made as to the source of the loan, depending on whether it is domestic or foreign. Domestic loans are assumed to belong to someone within the society and hence there are no outside suppliers of capital. Thus interest payments on domestic loans are not deducted from the gross return as a cost in deriving the cash flow. On the other hand, interest payment on foreign loans must be deducted from the gross return as a cost in deriving the cash flow.

Another thing that requires attention in preparing an economic analysis is the existence of subsidies, which raise no problem in financial analysis. Any subsidy reduces costs to private investors and thereby increases their incomes. In economic analysis however, adjustments must be made to market prices to reflect the amount of any subsidy. If subsidies are used to reduce costs of factors of production, then the amount of subsidies must be added to the market price of the commodity before entering it in the economic analysis. If the subsidy is used to reduce the prices, then the amount of the subsidy must be added to the market value of the product.

2.2. Sensitivity analysis

One of the real advantages of careful financial and economic analysis of a project is that it may be used to test what happens to the earning capacity if something goes wrong. Reworking an analysis to see what happens under a change of assumptions is termed sensitivity analysis. It is one means of trying to deal with a key reality of project analysis: the fact that projections are subject to a high degree of uncertainty about what will happen. Therefore all projects should be subjected to sensitivity analysis (Gittinger 1972,p.99). If after undertaking sensitivity analysis, the project still passes the criteria adopted by the evaluator then confidence in the project's economic viability is increased.

In this study, a number of sets of assumptions are used to assess how sensitive the project is to these changes. These assumptions are : first, the different interest rate employed in the credit arrangement, how sensitive the project is, if the

interest rate of the credit is 24 percent annually or 2 percent monthly, rather than 12 percent annually or 1 percent monthly; second, the different amount of import tax; the effect of a change of import tax to 50, 75, and 100 percent; third, the effect of a change of exchange rate from US dollar to rupiah that is from US$ 1 equivalent to Rp 415 into Rp 625, as a result of the devaluation of 1978.

This analysis is to assess the effect of each of the assumptions mentioned above taken in all possible combinations, on the total hand-tractor cost per annum, rental fee per hectare, total income per year, cultivation cost per hectare, and annual profit or loss.

2.3. Evaluation criteria

As stated previously in this chapter, three criteria namely NPV, B/C ratio, and IRR are used in assessing the profitability of the hand-tractor leasing project in Kabupaten Badung, Gianyar, and Tabanan, Bali. All three criteria are employed in analysing from the viewpoint of the tractor owners, as well as the society as a whole. The aim of the procedure followed in financial analysis is to see whether or not the project from the tractor owners viewpoint has passed the criteria NPV greater than 0, B/C ratio greater than 1, and IRR greater than the chosen discount rate, using the base data of prevailing market prices. A similar procedure is followed in the social or economic analysis of the project using the base data from the point of view of the society as a whole including the current shadow prices of unskilled labour, foreign exchange, and social opportunity cost of capital.

CHAPTER 3

FINANCIAL ANALYSIS

In this chapter, the financial analysis will be from the point of view of both the tractor owner and the renter. As specified earlier, the data to be used in this study is based on two previous surveys done by the Sub-Directorate of Agricultural Mechanization, Department of Agriculture (1976) entitled "Feasibility Study Pengembangan Tractor Pertanian di Kabupaten Badung, Gianyar, Tabanan Propinsi Bali", and by a team survey of Rural Dynamic Study the Agro-Economic Survey (1977) entitled "Feasibilitas Ekonomi Proyek Leasing Hand-Tractor dan Impak Potensiilnya Terhadap Kesempatan Kerja di Kabupaten Badung, Gianyar, dan Tabanan Bali". For simplicity the former survey will be called the Department of Agriculture survey (1976) and the latter the SAE survey (1977); and the data of these surveys will be called Department of Agriculture data and SAE data respectively. Before further analysis be done, it is necessary to summarise the aims and some findings of these surveys.

3.1. Department of Agriculture survey (1976)

The aim of this survey was to study the problems of power (human labour and draft animal) for land cultivation and to examine an alternative way of solving the problem by introducing hand-tractors or power tillers. The data findings

showed that the average income of farmers can be increased by raising production through expanding cropping intensity, intensification program (Bimas or Inmas), and by implementing the "kerta masa" system. One of the limiting factors in achieving this, is the difficulty in getting power (human labour and draft animal) for land cultivation. This difficulty is shown by the ratio of land/labour and land/draft animal in 1974 as follows (table 3.1.) :

TABLE 3.1.

LAND/LABOUR AND LAND/DRAFT ANIMAL RATIO IN KABUPATEN BADUNG, GIANYAR, AND TABANAN IN 1974

No.	Kabupaten	Land/labour ratio (ha/person)	Land/animal ratio (ha/pair of animal)
1.	Badung	1.3	3.2
2.	Gianyar	1.3	2.7
3.	Tabanan	2.2	2.7

Source : Soedjatmiko et al (1976)

Under normal conditions, the capacity of human labour is about 0.5 - .07 hectare per season, and 1 - 2 hectares per pair of draft animals per season.

The difficulty in getting human labour for hoeing is mostly due to young farmers, particularly the educated ones, preferring non-agricultural work because it pays better and involves less drudgery. The problem with draft animals is that fodder is not readily available because all land areas are used intensively for "sawah"; a second reason is that farmers

prefer to use cattle for beef production or breeding purposes as both of these are more profitable.

As a result of the difficulty in getting power for land cultivation, the "kerta masa" system cannot be employed and thus the "tulak sumur" (4) system must be implemented. This causes the plantation period to be much longer and consequently the cultivation is not intensive; for example, in Gianyar (1975), 250 hectares of "sawah" could not be well cultivated, so they could not join the Bimas program. Another consequence is that crop disease will spread more readily and causes crop failure.

The introduction of hand-tractors could be accepted as one way of solving the problem provided that the number of hand-tractors to be introduced would be limited and would only supplement existing labour not replace it, so that job opportunities in the villages are not reduced as a result of introducing tractors. The survey consider that a maximum of 346 hand-tractors is sufficient for Badung, 363 for Gianyar, and Tabanan 457 (based on equivalent with a power 7 - 8 HP). If the hand-tractor could effectively exploit 20 hectares per season with a cultivation cost Rp 16,042 per hectare, this cost is cheaper by about Rp 8,950 - Rp 13,000 than using human labour or draft animals. The study suggests that with these figures, the operation of hand-tractors will have NPV = Rp 482,612; B/C ratio = 1.2 (at i=12 percent); and IRR = 23

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(4) "Tulak sumur" is a rice cultivation system in which all farming activities are done individually, even for "sawah" under the same "subak".

percent. From this figures it is obvious that the operation of hand-tractors is financially profitable. Another benefit from the use of hand-tractors as compared to draft animals is that farmers will not compete for the use of land, hence all land can be cultivated for rice or other food crops and tractors can work faster so they become more compatible with the "kerta masa" system. The important fact is that this will alleviate the burden of power for land cultivation.

The objection to the use of a tractor is its purchase price which is too expensive if compared to the production result or the price of a draft animal, the size of the rice field and the operations of the farmer (which are relatively small), and the skill of the farmer in operating and maintaining the tractor (which is not yet sufficient). On top of that, it will replace human labour and cause unemployment.

To introduce the hand-tractors smoothly, the survey recommends that it is necassary to arrange a close cooperation between various institutions especially the local government, the local Department of Agriculture, The Directorate of Cooperatives, Banks, the private sector or dealers, and the farmers' institutions themselves. The ideal ownership status is by "KUD/BUUD" (5) or a group of farmers or persons with cultivation under the same "subak".

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(5) KUD : village unit cooperative
BUUD : village unit institution, later became KUD

3.2. SAE survey (1977)

With the purpose of alleviating the problem of a shortage of draft animals and human labour for "sawah" cultivation in Kabupaten Badung, Gianyar, and Tabanan, a multi-institutional approach leasing project (6) was planned to introduce 1,044 hand-tractors to Bali during the period of 1977-1978, to be financed with credit from the Bank Indonesia. To assist in deliberations on the provision of credit for this leasing project, a survey was conducted. The survey was based on the following questions :

a. whether hand-tractor operation in Kabupaten Badung, Gianyar, and Tabanan are financially profitable, and

b. whether there is sufficient evidence of agricultural power shortage to support the plan to introduce a large number of hand tractors to Bali.

The survey was carried out in 9 sample villages, and data were collected from a number of sources. Interviews were held with farmers, village and "subak" leaders, and tractor owners and operators. Secondary data were obtained from the local office of the Department of Agriculture in each Kabupaten, the villages and 10 of the first 30 recipients of hand-tractors under this leasing project. The data findings showed that the actual performance of hand-tractors already in operation is only 16 ha, 17 ha, and 20 ha per season in Kabupaten Badung,

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(6) A multi-institutional approach leasing project is a leasing project which is conducted by more than one institution whether state, private, or both.

Gianyar, and Tabanan respectively, or an average of about 18 ha per season. Although this performance is very low, especially if compared to the proposal of the leasing project that hand-tractors in the project can be expected to cultivate 40 hectares per season, in order to achieve this 18 hectares per season the tractors were also operated outside the village. As it is clear that the performance of the existing hand-tractors already in operation is less than 50 percent of the 40 ha per season as expected by the leasing project, then lessees will be unable to make their instalment payment of the credit in line with the schedule, that is 3 years.

Based on the sample of hand-tractors already in operation, the financial analysis by employing NPV,B/C ratio, and IRR criteria was as follows (table 3.2.):

TABLE 3.2.

PROFITABILITY OF HAND-TRACTOR OPERATION IN KABUPATEN BADUNG, GIANYAR, AND TABANAN (1977)

Kabupaten	NPV (12%) Rp	B/C (12%)	IRR
1. Badung	- 181,371	0.896	1.33
2. Gianyar	- 77,116	0.962	7.99
3. Tabanan	- 319,027	0.826	1.0

Source : Sinaga et al (1977)

From the table above, it is obvious that based on the NPV,B/C ratio, and IRR criteria, the tractor operations at present are not financially profitable, and it may be assumed for the same reason that the leasing project will also result in losses both

for the lessees and the creditor. The most important crucial factor is the limited physical performance of the tractors in terms of hectares cultivated per season, as mentioned above.

Comparative analysis indicates that "sawah" cultivation by rented tractor is cheaper than cultivation with traditional methods of animal and human labour. The difference in cost is: 17 percent in Badung, 30 percent in Tabanan, and none in Gianyar. However, this cost advantage is only possible because of the indirect subsidies provided to tractor-owners in the form of (1) low interest rates from the Bank (1 percent per month), (2) the pegging since 1971 of the rupiah-dollar exchange rate, and (3) low import tax (20 percent of cif).

According to respondents in the sample village where hand-tractors have been used, there is no difference in yields when "sawah" is cultivated by tractor compared to traditional methods. The farmers who rented hand tractors were not motivated by a shortage of agricultural power (animal and human labour) but because it was cheaper, and they preferred to complete their cultivation quickly, even when this was not necassary in order to meet the "subak's" planting deadlines. They just saved themselves worry if the job was quickly completed.

From various data collected, there is no evidence to support the assumption of shortage of human and animal labour for "sawah" cultivation, nor of the occurrence of a shifting of agricultural labour force to non-agricultural occupations, in order to obtain better wages. Furthermore, the introduction of hand-tractors into villages in Bali has resulted in various

socio-economic problems in the village society, such as :

a. a reduction of employment opportunities for small farmers and landless labourers,

b. the withdrawal of sharecropping rights by larger land owners who wish to manage the cultivation themselves, and

c. the increasing inequality of rural income distribution, due to the factors mentioned above and also because the majority of cultivation costs in tractor cultivation no longer fall into the hands of a large number of labourers (hoers and ploughmen) in the form of wages, but rather into the hands of a small number of importers, dealers, fuel and oil suppliers, mechanics, operators, the owners, and manufacturers of tractors overseas.

From the two summaries above, it is obvious that the outcomes of these two surveys are contradictory, even though they were conducted in the same region. To compare the differences of these outcomes, it is better to look further at the data summarised from these surveys as shown in table 3.3. From the table, particularly item 8 (financial cost-benefit analysis), it is clear that the outcome of these surveys are contradictory. The outcome of the Department of Agriculture survey showed that the NPV is greater than 0, B/C ratio is greater than 1, and the IRR is greater than 12 percent, that is the discount rate to be used in the analysis.

TABLE 3.3.

SUMMARY DEPARTMENT OF AGRICULTURE DATA AND AGRO-ECONOMIC SURVEY DATA

No.	Items	Unit	Dept.of Agric. (1976)	SAE (1977)
1.	Price of tractor	Rp	1,300,000	1,180,630
2.	Capacity of tractor per ha	hr	20	20
3.	Area cultivated by tractor per season	ha	20	18
4.	Rental fee of tractor per ha	Rp	16,042	18,981
5.	Operating cost per ha :			
	a. Fuel	lt	25	23.4
	Cost : Rp 30/lt	Rp	750	702
	b. Lubricating oil	lt	1.6	1.4
	Cost : Rp 400/lt	Rp	640	560
	c. Operator wage	Rp	2,250	4,615
	d. Maintanance cost	Rp	3,120	2,712
6.	Economic life of tractor	Year	7	3
7.	Salvage value	%	10	10
8.	Fin. cost-benefit analysis :			
	a. NPV	Rp	486,000	- 178,000
	b. B/C ratio		1.2	0.9
	c. IRR	%	23	2
9.	Cultivation cost by tractor per hectare	Rp	17,242	18,981 (23,736) [1]
10.	Total mandays cultivation by tractor per hectare	md [2]	2.86	2.84 (11.7) [1]
11.	Cultivation cost per hectare:			
	a. by human labour only	Rp	29,075	-
	b. by draft animal only	Rp	25,000	-
	c. combination a & b	Rp	-	28,361
12.	Capacity per hectare :			
	a. human labour only	md	61	-
	b. draft animal only	ad [3]	17	-
	c. Combination a & b	md+ad	-	36 + 13

Notes : 1) in brackets : including extra work and extra work cost

2) 1 md = 7 hours

3) 1 ad = 5 hours

Sources: Department of Agriculture : Soedjatmiko et al (1976, opcit)

Agro-Economic Survey : Sinaga et al (1977, opcit)

Thus, according to the Department of Agriculture survey the introduction of hand-tractors in Kabupaten Badung, Gianyar, and Tabanan will be financially profitable. In contrast, the findings of the SAE survey showed that the NPV is less than 0, B/C ratio less than 1, and the IRR less than 12 percent, that is the discount rate to be used in the analysis. So that according to SAE survey the introduction of hand-tractors in Kabupaten Badung, Gianyar, and Tabanan will be financially unprofitable.

If we look further at the items of data used in the analysis, we find that some items of data used in these analysis are different, such as the price of tractors, the area cultivated by tractors per season, rental fee of the tractor per ha, operating cost per ha, and the assumption of the economic life of the tractor. As previously mentioned in chapter 2, cost-benefit analysis takes into consideration the timing of cash flows, thus the factor of the economic life of a tractor plays an important role. Since there are relatively big differences in the assumption of the economic life of a tractor between Department of Agriculture data (7 years) and SAE data (3 years), the author suggest that this is the main reason why the outcomes of these surveys are different.

Other differences in the data presented above are cultivation cost by tractor per ha, and total mandays of cultivation by tractor per hectare if the extra work (7) is

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(7) Extra work is work done by human labour to complete the land preparation done by tractor

included. If the data does not include the extra work, then the total mandays of cultivation by tractor per ha would be almost the same. Data for cultivation costs and capacity of draft animal and human labour per ha are not comparable, since Department of Agriculture data separates cultivation costs and the capacity of human labour and draft animals, but the SAE data combines both.

3.3. Financial cost-benefit analysis

In this section a financial cost-benefit analysis will be carried out from the viewpoint of the tractor owner and renter. Data used in the analysis will be drawn from these two surveys (table 3.3.). A single data set will be developed by choosing from these two sources (summarised in table 3.4.) the data which are sound and logically reasonable. The basic data set thus chosen will be used for financial cost-benefit analysis, are presented in table 3.6..

TABLE 3.4.

BASIC DATA USED FOR FINANCIAL COST BENEFIT ANALYSIS

No.	Items	Unit	Dept.of Agric. (1976)	SAE (1977)
1.	Price of tractor	Rp	1,300,000	1,180,630
2.	Capacity of tractor per ha	hr	20	20
3.	Area cultivated by tractor per season	ha	20	18
4.	Rental fee per hectare	ha	16,042	18,981
5.	Operating cost per hectare:			
	a. Fuel	lt	25	23.4
	Cost : Rp 30/lt	Rp	750	702
	b. Lubricating oil	lt	1.6	1.4
	Cost : Rp 400/lt	Rp	640	560
	c. Operatoe wage	Rp	2,250	4,615
	d. Maintenance cost	Rp	3,120	2,712
6.	Economic life of tractor	Year	7	3
7.	Salvage value	%	10	10

Source : Derived from table 3.3.

3.3.1. Price of tractor

The data used by the Department of Agriculture survey was based on the latest price of hand-tractors in Bali in 1976; SAE data is based on the average price of tractors bought by the sample respondents. Since most of the respondents bought the tractors more than one year before the survey was conducted, the data used bu the Department of Agriculture is probably more accurate. Information from dealers that the c and f price of a hand-tractor is US$ 1,507.59 and calculations by dealers found that the price of a tractor (7-8 HP) in Jakarta was Rp 1,217,377 (Appendix 3.3.). If the price of a

tractor in Bali was Rp 1,300,000 it is reasonable to assume that the difference in these prices is due to transport costs from Jakarta to Bali. Hence for this analysis the data from the Department of Agriculture survey will be used, that is Rp 1,300.000.

3.3.2. Capacity of tractor per hectare

Though data from the Department of Agriculture survey was based on field tests and the SAE data was based on average tractor performance, the results are the same and therefore this data is used for further analysis.

3.3.3. Area cultivated by tractor per season

The data used by the Department of Agriculture is the expected area which should be cultivated by tractor per season, while the SAE data is the average of actual performance of tractors already in operation. It is reasonable, then, to choose the SAE data to be used in this study.

3.3.4. Rental fee of tractor per hectare

In considering the rental fee, the Department of Agriculture is based on the formula Diametan-72 (8), that is :

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(8) Diametan is "Dinas Alat-alat dan Mesin Pertanian", the previous name of Sub-Directorate of Agricultural Mechanization.

$$Tc = \left(\frac{A}{X} + b\right) \times C$$

where : Tc = cultivation cost per hectare for rice

A = capital recovery (depreciation included)

X = total working hours per year or season

b = operating cost per hectare (consists of fuel, oil, operator's wage, and maintenance or repair cost)

C = capacity of tractor per hectare (hr/ha)

Using this formula and data (table 3.4.), the value of Tc (cultivation cost) per hectare and area cultivated by tractor per season in the range of working hours per season (X) between 100 - 800 hours are as follows (table 3.5.).

TABLE 3.5.

CULTIVATION COST PER HA AND AREA CULTIVATED BY TRACTOR PER SEASON IN VARIOUS TOTAL WORKING HOURS PER SEASON (1976)

Working hours per season (hr)	Cultivation Cost (Rp/ha)	Area cultivated per season (ha)
100	34,606	5
200	20,683	10
300	16,042	15
400	13,722	20
500	12,329	25
600	11,401	30
700	10,738	35
800	10,241	40

Source : Soedjatmiko et al, (1976, Opcit)

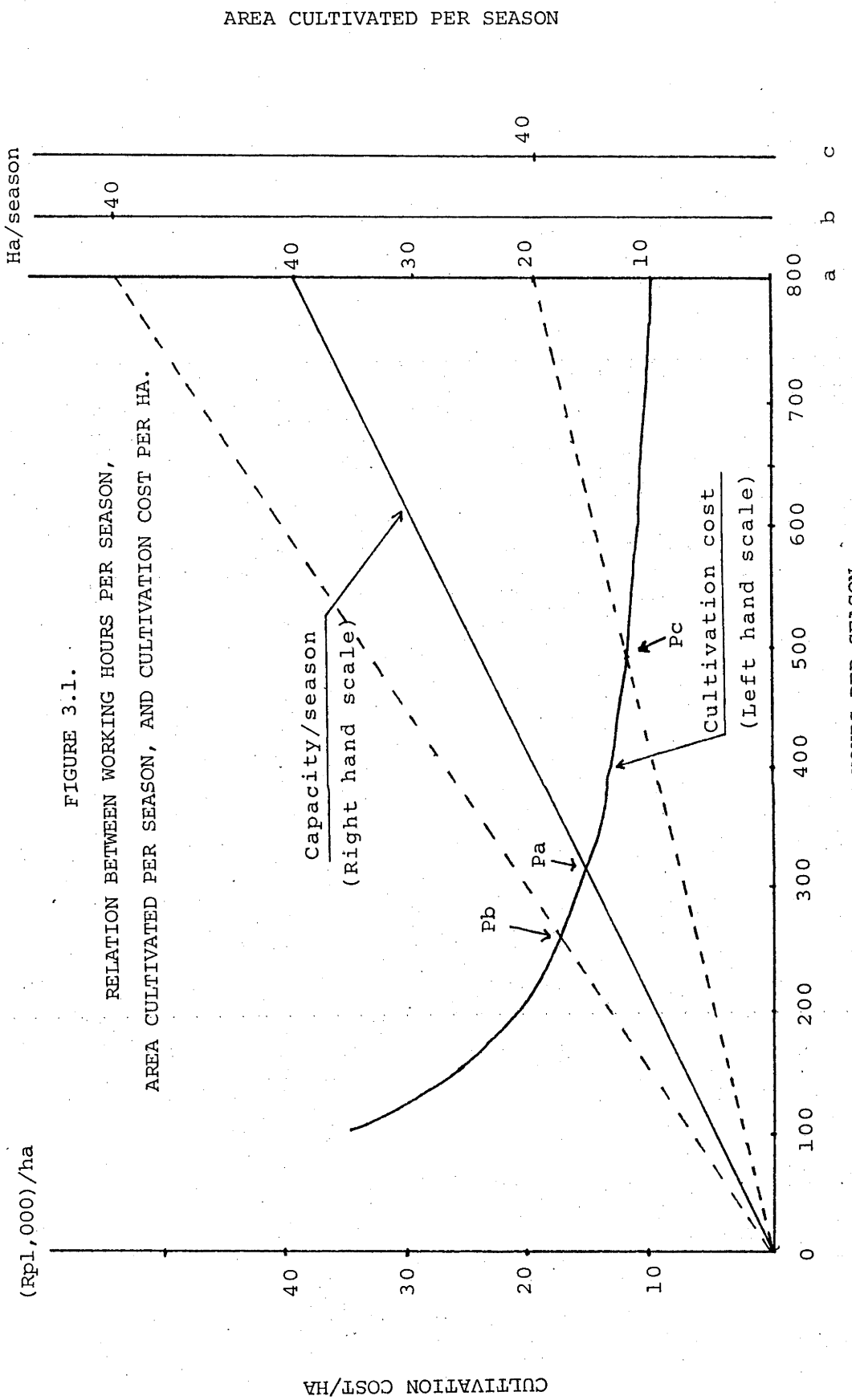

FIGURE 3.1.

RELATION BETWEEN WORKING HOURS PER SEASON, AREA CULTIVATED PER SEASON, AND CULTIVATION COST PER HA.

Three scales are shown (scales a, b, and c) to show that the choice of scale is crucial in effecting the point P (point of intersection)

Then the calculations above were plotted on a graph (figure 3.1.). From the figure it is clear that the cultivation cost line and the capacity line intersect at point Pa, that is the point between working hours 300-400 per season, between the cultivation cost Rp 13,722 - Rp 16,042 per hectare, and between the total area cultivated per season 15 - 20 ha. Thus, according to the figure above, the operation of hand-tractors will be profitable if they can cultivate an area of 15 - 20 ha per season at cultivation costs between Rp 13,722 - Rp 16,042 per hectare. Based on this consideration the Department of Agriculture expected that the working hours of the tractors is around 400 hours per season, in which the tractor can cultivate 20 ha of "sawah" and at a cultivation cost Rp 16,042 per ha, for its analysis. In fact this consideration is purely arbitrary because the cultivation cost line and the capacity line (figure 3.1.) intersect at point Pa just 'by chance', that is, if we change the scale of the area cultivated per season axis (right hand scale), then the capacity line will shift upward or downward depending on the scale of the axis (dotted line), and this line will intersect the cultivation cost line at a different point (Pb or Pc), and gives a different result of expectation of cultivation cost as well. Thus, this determination will give a biased result. On the other hand, in determining the rental fee of a tractor per ha, the SAE data was based on the average rental fee of tractors existing in the study area, that is Rp 18,981 per ha.

Theoretically, the rental fee of a tractor is based on the annual costs which include fixed costs and operating (variable) costs. Fixed costs consist of depreciation (generally for

simplicity this is calculated as straight line depreciation), interest, taxes, insurance, and shelter; and operating costs consists of fuel, oil, operator's wage, and maintenance or repair costs. The formula for estimating the annual fixed cost for a tractor is as follows :

No.	Items	Formula	Rule of thumb (%)
1.	Depreciation	$\frac{\text{Purchase Price - Salvage Value}}{\text{Estimated years of life}}$	7 - 15
2.	Interest	$\frac{\text{Price + Salvage Value}}{2} \times \text{Interest rate}$	3.3 - 4.0
3.	Taxes	$\frac{\text{Price}}{2} \times 0.55 \times \text{Tax rate}$ (refer to poverty)	1.0 - 1.3
4.	Insurance	$\frac{\text{Price}}{2} \times \text{Insurance rate}$	0.3 - 0.4
5.	Shelter	Price x (.5% - 3.5%)	1.2

Source : Herbst (1970,p.168)

According to the knowledge of the author, in Indonesia tractors are not being taxed annually like vehicles; for the purpose of this study it will be assumed that tractors are not being taxed as property. Insurance will be ignored in this study, since it is not yet widespread in Indonesia. Shelter will be neglected as well, because generally farmers do not build a special shelter for their tractors or other equipment. Hence, the

components of the fixed costs will only include depreciation and interest. The components of operating costs such as fuel, lubricating oil, operator's wage, and maintenance cost are discussed in the sub-section below. In line with the theoretical frame work above, the rental fee of a tractor per ha used in this study will be determined later conforming to the single data available.

3.3.5. Operating cost per hectare

As with the other items used for financial cost-benefit analysis, the operating cost of a tractor per hectare i.e. fuel, lubricating oil, operator's wage, and maintenance cost, the SAE data was based on the average operating cost for tractors already in operation in the study area. For fuel and lubricating oil, eventhough the Department of Agriculture data is based on the field tests conducted in the study area, the results are almost the same as the SAE data (table 3.4.).For the purpose of this study, however, it is better to use the Department of Agriculture data, that is, the amount of fuel used is 25 lt/ha and lubricating oil is 1.6 lt/ha. For operator's wage and maintenance cost per hectare, the Department of Agriculture used this formula :

a. Operator's wage/ha = 15% x cultivation cost

b. Maintenance cost/ha = (1.2%/100hrs x Price of tractor) x 20 hrs

(Soedjatmiko et all,1976, pp. 1-25,L-27).

using this formula, thus :

a. Operator's wage/ha = 15% x Rp 15,000 (9) = Rp 2,250

b. Maintenance cost/ha = (1.2%/100 x Rp 1,300,000) x 20 = Rp 3,120

To find the operator's wage, for the purpose of this study, it is better to use SAE data because it reflects the actual conditions. However, for maintenance cost, the author prefers to use Department of Agriculture data because though the SAE data is based on the average of actual maintenance or repair costs of existing tractors already in operation in the area study, it does not take into consideration the component included in determining this cost.

3.3.6. The economic life of the tractor

For financial cost-benefit analysis, the Department of Agriculture assumed that the economic life of a hand-tractor is 7 years with a salvage value of 10 percent; this assumption might be based on the technical useful life of the tractor. On the other hand, SAE assumed that the economic life of a hand-tractor is 3 years with a salvage value 10 percent, and as mentioned previously, this assumption is based on the credit period of the tractor. As both studies agree on the capacity of the tractor per hectare and the area cultivated by the tractor per season, in terms of working hours, the economic life of the tractor should be called 5,600 hours and 2,160

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(9) Rp 15,000 is the average cultivation cost in the study area, not includes meals and cigarettes.

hours according to Department of Agriculture and SAE respectively. As mentioned before , the author suggests that this different assumption of the economic life of a tractor is the main variable which causes the outcome of the financial cost-benefit analysis of these surveys to be different. As also mentioned earlier (chap. 2) there is no specific method for determining the economic life of a tractor. Generally the determination is based on the past performance or experience. Hence, for the purpose of this study the economic life of a hand-tractor will be assumed to be between 3,500 and 4,000 hours, and based on the data of capacity of a tractor per hectare and area cultivated by tractor per season (table 3.4.), we can assume that the working hours of the tractor per year is between 700 and 800 hours. Thus, in terms of years the economic life of the tractor can be determined as 5 years. The salvage value of the tractor after depreciation will be assumed to be 10 percent of the purchase price. Though, for the purpose of this study the economic life of the tractor will be assumed as 5 years with a salvage value 10 percent of the purchase price, however, it is necassary to make an analysis assuming the economic life of the tractor to be 3 years, since the period for which credit will be extended in the project is 3 years. Thus, the single data drawn from these surveys data are as follows (table 3.6.).

TABLE 3.6.

SINGLE DATA USED FOR FINANCIAL COST BENEFIT ANALYSIS

No.	Items	Unit	Data
1.	Price of tractor	Rp	1,300,000
2.	Capacity of tractor per ha	hr	20
3.	Area cultivated by tractor per season	ha	18
4.	Rental fee of tractor per ha	Rp	will be determined later
5.	Operating cost per hectare :		
	a. Fuel	lt	25
	Price : Rp 30/lt	Rp	750
	b. Lubricating oil	lt	1.6
	Price : Rp 400/lt	Rp	640
	c. Operator wage	Rp	4,615
	d. Maintenance cost	Rp	3,120
6.	Economic life of tractor	hr	3,500 - 4,500
		year	(5)
7.	Salvage value	%	10

From the data presented above, the rental fee of the tractor per hectare can be determined (at discount rate 12 percent year), as follows :

Items	Calculation	Result (Rp)
I. Fixed cost :		
a. Depreciation	$\frac{1{,}300{,}000 - 130{,}000}{5 \times 18 \times 2}$	6,500
b. Interest	$\left(\frac{1{,}300{,}000 + 130{,}000}{2} \times 12\%\right) : 2 \times 18$	2,383
	Total fixed cost :	8,883
II. Operating cost :		
a. Fuel	25 x 30	750
b. Oil	1.6 x 400	640
c. Operator's wage		4,615
d. Maintenance cost	$\left(\frac{1.2\%}{100} \times 1{,}300{,}000\right) \times 20$	3,120
	Total operating cost:	9,125
Cultivation cost/ha	8,883 + 9,125	18,008

Thus, the minimum rate of rental fee of the tractor per hectare is approximately Rp 18,000. At this stage the tractor owner will gain nothing because all the rental fee will be used for credit repayment plus interest and to pay fuel, lubricating oil, operator's wage, and saving for maintenance. Suppose the tractor owner is expecting a profit of 10 percent of the rental fee per hectare, in addition to Rp 18,000., then the total will be Rp 19,800. Based on this rental fee and the assumption of the economic life of the tractor as 5 years with a salvage value 10 percent, and at an interest rate of 12 percent per year, using criteria NPV, B/C ratio, and IRR, the financial

cost-benefit analysis from the tractor's owner point of view are :

a. NPV = Rp 184,000

b. B/C = 1.07

c. IRR = 17.8 percent

(see appendix 3.4. for details)

Since the NPV is greater than 0, B/C ratio is greater than 1, and the IRR is greater than 12 percent (discount rate used in the analysis), the project is financially profitable.

From the analysis above, it is clear that hiring a tractor is financially profitable from the view point of the tractor owner, as long as the rental fee of the tractor per hectare is less than the cultivation cost by traditional methods, otherwise the farmers will not want to hire the tractor. If the extra work cost is included, then the total cultivation cost by tractor is Rp 24,555 per hectare (10), this cost is still less than cultivation costs using traditional methods, such as using human labour only, draft animal only, or a combination of human and draft animal labour. The difference in cost per hectare is Rp 4,520 or 18 percent for human labour only, Rp 3,806 or 16 percent for combination human and draft animal labour, and Rp 445 or 2 percent for draft animal labour only.

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(10) Rp 24,555 = Rp 19,800 + (Rp 23,736 - Rp 18,981), see table 3.3.

Now, if we take into consideration that the instalment period of the credit is 3 years or 6 seasons, so that the assumed economic life of the tractor is 3 years, the calculation of the rental fee of the tractor per hectare is as follows :

Items	Calculation	Result (Rp)
I. Fixed cost :		
a. Depreciation	$\frac{1{,}300{,}000 - 598{,}000\ (11)}{3 \times 18 \times 2}$	6,500
b. Interest	$(\frac{1{,}300{,}000 + 598{,}000}{2} \times 12\%) : 2 \times 18$	3,163
	Total fixed cost :	9,663
II. Operating cost		9,125
Cultivation cost/ha	9,663 + 9,125	18,788

Hence, the minimum rate of rental fee of the tractor per hectare is Rp 18,788. Again suppose the tractor owner is willing to accept 10 percent profit, in addition to Rp 18,788.

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(11) In determining salvage value, it must be based on the depreciation when the assumption of the economic life of the tractor is 5 years with a salvage value of 10 percent is employed, thus :

$$\text{Salvage value} = 100\% - (\frac{100\% - 10\%}{5}) \times 3 = 46\%$$

$$= 46\% \times \text{Rp } 1{,}300{,}000 = \text{Rp } 598{,}000$$

then the rental fee per hectare will be Rp 20,667. Based on this rental fee and the assumed economic life of the tractor of 3 years with a salvage value of 46 percent instead of 10 percent, and at an interest rate of 12 percent per year, using the criteria of NPV, B/C ratio, and IRR, the financial cost-benefit analysis from the owner's point of view is :

a. NPV = Rp 143,000

b. B/C = 1.07

c. IRR = 17.6 percent

(see appendix 3.5. for details).

Since the NPV is greater than 0, B/C is greater than 1, and the IRR is greater than 12 percent (discount rate used in the analysis), the project is financially profitable.

From the analysis above, the leasing project is still profitable, even when the economic life of the tractor is assumed as 3 years, but with a salvage value of 46 percent . If the extra work cost is included, then the total cultivation cost per hectare will be Rp 25,422. (12) This cost is still lower than cultivation costs using traditional methods such as using human labour only or a combination of human and draft animal labour, but higher than cultivation costs with draft animal labour only. The difference in cost per hectare is Rp 3,653 or 14 percent for human labour only, and Rp 2,939 or 12 percent for combination human and draft animal labour, and Rp

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(12) Rp 25,422 = Rp 20,667 + (Rp 23,736 - Rp 18,981), see table 3.3.

422 or 2 percent higher than using draft animal labour only.

According to the proposal of the leasing hand-tractor project, the project will be profitable if the rental fee of a tractor per hectare is Rp 19,766 and cultivation capacity of a tractor per season is 40 hectares (Sinaga et al. 1977,p.11), even when the economic life of a tractor is assumed to be 3 years with a salvage value of 10 percent. Using the criteria of NPV, B/C ratio, and IRR, this project is financially profitable with:

a. NPV = Rp 818,000

b. B/C = 1.26

c. IRR = 49 percent

(see appendix 3.6. for details).

This result is understandable because although the economic life of the tractor is assumed as only 3 years, the area cultivated per season is high (that is, expected to be 40 hectares). This means that in terms of working hours, the economic life of the tractor is assumed to be 4,800 hours (13), this is longer than the assumption of economic life of the tractor to be used in this study (3,500 - 4,000 hours). In agreement with the data findings of the SAE survey, that the actual performance of tractors already in operation is only 18 hectares per season, it seems very hard to achieve the performance 40 hectares per season. If the analysis is based

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(13) 4,800 hours = 40 ha/season x 6 season x20 hours/ha

on the data as proposed by the leasing hand-tractor project, but for area cultivated per season using the data used in this study (18 hectares per season), it is clear that the project will be financially unprofitable. However, if the economic life of the tractor is assumed to be 5 years with a salvage value 10 percent, using the criteria of NPV, B/C ratio, and IRR the project will still be financially profitable with :

a. NPV = Rp 167,000

b. B/C = 1.07

c. IRR = 17.6 percent

(see appendix 3.7. for details).

From the discussion above, it can be concluded that the introduction of hand-tractors in Kabupaten Badung, Gianyar, and Tabanan would be financially profitable from the point of view of the tractor owner if :

1. The cultivation cost by a tractor per hectare is less than the cultivation cost by traditional methods.

2. The economic life of the tractor is assumed around 3,500 - 4,000 hours, thus the number of years will depend on the working hours of the tractor per year.

3. The tractor could operate at a capacity of 20 hours per hectare and during a season can cultivate around 20 hectares.

The financial cost-benefit analysis from the view point of the tractor renter is calculated from the difference between cultivation costs with and without the tractor. The cultivation costs per hectare by various method are (table 3.7.) :

TABLE 3.7.

CULTIVATION COST PER HECTARE BY VARIOUS KIND OF METHODS

No.	Methods	Cost (Rp)
1.	By tractor, without extra work[1)]	19,800
2.	By tractor, with extra work	24,555
3.	By human labour only	29,075
4.	By draft animal only	25,000
5.	By combination human labour and draft animal	28,361

Note : 1) extra work is work done by human labour to complete land preparation done by tractor

Based on the table above, by comparing these cultivation cost, we can calculate the saving of the tractor renters per hectare when they use the tractor for land preparation, as follows (table 3.8.) :

TABLE 3.8.

SAVINGS IN CULTIVATION COST PER HECTARE WHEN A TRACTOR IS USED WITH AND WITHOUT EXTRA COST

No.	Methods	With extra cost		Without extra cost	
		Rp	%	Rp	%
1.	Compare to human labour	4,520	18	9,275	47
2.	Compare to draft animal	445	2	5,200	26
3.	Compare to combination human labour & draft animal	3,806	15	8,561	43

From the table above, it is obvious that hiring a tractor is financially profitable from the point of view of the tractor renter.

An additional gain to the tractor renters is that they can complete the cultivation quickly in order to meet the "subak" plantation schedule, so they can implement the "kerta masa" system, and then they can use the rest of the time for other activities that should give them additional income or at least leisure. In addition to this, by using the tractor for land preparation, an increase in productivity of land (in terms of cropping intensity) will result. Using the 'standard' IBRD, assumption mentioned before (chap. 1), the use of the tractor for land preparation could increase cropping intensity by at least 20 percent, and if we assume the average yield per hectare is 4 tons of rough rice (table 1.8), an increase in cropping intensity of 20 percent can be converted to 20 percent of 4 tons, that is, 0.8 ton or 8 quintals.

3.4. Sensitivity analysis

Farmers tend to hire tractors because they are cheaper than the traditional methods. Another reason is in order to meet the "subak's" schedule for irrigation and planting deadlines acrding to the implementation of the "kerta masa" system. It is suggested that the cheaper cultivation costs of the tractor are due to some subsidies (direct and indirect) from the government, in terms of low interest rates from the state bank, low import tax, and the pegging since 1971 of rupiah-dollar exchange rates (Sinaga et al.1977,p.4;Sinaga 1978,p.107). In this section,sensitivity analysis will be

conducted to test the influence of interest rates, import tax, and exchange rates on the tractor price, tractor cost per year, rental fee per hectare, income per year, annual profit or loss, and the cultivation cost per hectare. In this analysis two kinds of interest rates are chosen: 12 percent per year or 1 percent per month (the existing interest rate to be used in the analysis), and 24 percent per year or 2 percent per month (based on the minimum interest rate from commercial bank without any subsidy). Four kinds of import tax are employed in this analysis :

a. 20 percent cif (the exixting import tax)

b. 50 percent cif

c. 75 percent cif

d. 100 percent cif

The exchange rate to be used in this analysis is the official exchange rate before and after devaluation, that is Rp 415 and Rp 625 rationing to US$ 1.- All data use in this analysis are from the previous analysis (table 3.5.). The results are presented in tables 3.9. and 3.10.

SENSITIVITY ANALYSIS OF TRACTOR OWNER'S COST AND RETURN PER YEAR BY DIFFERENT

IMPORT TAX, INTEREST RATE, AND EXCHANGE RATE

US $ 1 = Rp 415

I t e m s	20% CIF		50% CIF		75 CIF		100% CIF	
	12%	24%	12%	24%	12%	24%	12%	24%
1. Price of tractor	1,300,000	1,300,000	1,464,151	1,464,151	1,716,760	1,716,760	1,906,573	1,906,573
2. Total cost per year[1)]	648,000	734,112	688,681	785,315	750,823	864,129	797,517	923,351
A								
3. Rental fee of tractor per ha	19,800	19,800	19,800	19,800	19,800	19,800	19,800	19,800
4. Total income per year[1)]	712,800	712,800	712,800	712,800	712,800	712,888	712,800	712,800
5. Annual profit/loss	64,800	- 21,312	24,119	- 72,515	- 38,023	-151,329	- 84,717	-210,551
B								
6. Rental fee of tractor per ha[2)]	19,800	22,431	21,043	23,995	22,942	26,404	24,368	28,214
7. Total income per year[1)]	712,800	807,516	757,548	863,820	825,912	950,544	877,248	1,015,704
8. Annual profit/loss	64,800	73,404	68,867	78,505	75,089	86,415	79,731	92,353
9. Cultivation cost per hectare[3)]	24,555	27,186	25,798	28,750	27,697	31,159	29,123	32,969

Notes : A. Calculation based on the constant rental fee of tractor per hectare

B. Calculation based on the adjusted rental fee of tractor per hectare

1. Capacity of tractor is 18 hecatres per season (36 ha per year)
2. Tractor owner is willing 10% profit from the tractor cost per hectare
3. With extra work cost (Rp 4,755/ha)

SENSITIVITY ANALYSIS OF TRACTOR OWNER'S COST AND RETURN PER YEAR BY DIFFERENT

IMPORT TAX, INTEREST RATE, AND EXCHANGE RATE

US $ 1 = Rp 625

I t e m s	20% CIF		50% CIF		75% CIF		100% CIF	
	12%	24%	12%	24%	12%	24%	12%	24%
1. Price of tractor	1,879,770	1,879,770	2,222,805	2,222,805	2,508,667	2,508,667	2,788,841	2,788,841
2. Total cost per year[1)]	790,923	914,988	875,310	1.022,015	945,632	1,111,204	1,014,555	1,198,618
A								
3. Rental fee of tractor per ha	19,800	19,800	19,800	19,800 1	19,800	19,800	19,800	19,800
4. Total income per year[1)]	712,800	712,800	712,800	712,800	712,800	712,800	712,800	712,800
5. Annual profit/loss	- 78,123	-202,188	-162,510	-309,215	-232,832	-398,404	-301,755	-485,818
B								
6. Rental fee of tractor per ha[2)]	24,167	27,958	26,745	31,228	28,895	33,954	31,000	36,625
7. Total income per year[1)]	870,012	1,006,488	962,820	1,124,208	1,040,220	1,222,344	1,116,000	1,318,500
8. Annual profit/loss	79,089	91,500	87,510	102,193	94,588	111,140	101,445	119,882
9. Cultivation cost per hectare[3)]	28,922	32,713	31,500	35,983	33,650	38,709	35,755	41,380

Notes : A. Calculation based on the constant rental fee of tractor per hecatre

B. Calculation based on the adjusted rental fee of tractor per hectare

1. Capacity of tractor is 18 hecatres per season (36 ha per year)
2. Tractor owner is willing 10% profit of the tractor cost per hectare
3. With extra work cost (Rp 4,755/ha)

From table 3.9. when the exchange rate is Rp 415 rationing to US$ 1 (before devaluation), if the interest rate is 12 percent per year, assuming the rental fee is held constant (Rp 19,800), the tractor owner only makes a profit when the import tax is 20 percent and 50 percent cif. If the interest rate is 24 percent per year, the tractor owner will make a loss rather than a profit, though the import tax is 20 percent cif. However, if the rental fee of the tractor per hectare can be adjusted (calculation B) the tractor owner will make a profit at any interest rate and import tax, but the cultivation cost will then increase and exceed the cultivation cost by traditional methods. In this case the farmers will be reluctant to lease the tractors. Only at an interest rate of 12 percent yearly and an import tax of 20, 50, and 75 percent cif, and at an interest rate of 24 percent yearly with an import tax of 20 and 50 percent cif, is the adjusted cultivation cost by tractor still cheaper than traditional ones.

Table 3.10 shows the sensitivity analysis when the exchange rate is Rp 625 for US$ 1 (after devaluation). In this case whether the rental fee is held constant or adjusted, the tractor owner will make a loss at any interest rate and import tax. Infact, when the rental fee is adjusted, the tractor owner will make a profit at any interest rate and import tax, but because the cultivation cost, then, is higher than by traditional methods, none of the farmers will hire tractors.

From the discussion above, it can be concluded that the introduction of hand-tractors will be profitable from the viewpoint of the tractor owner, only if the government gives

protection in terms of subsidies. At present (after devaluation) these subsidies must be much higher than before. It depends on the government, whether it will give protection or not to the leasing hand-tractor project. If the project gains social acceptance, it is reasonable for the government to give protection to the project. The social or economic analysis will be discussed in chapter 4.

CHAPTER 4

ECONOMIC ANALYSIS

This chapter deals with the economic or social analysis of the leasing hand-tractor project in Kabupaten Badung, Gianyar, and Tabanan, in the province of Bali. As mentioned in chapter 1, the first objective of this study is to find out whether the operation of a hand-tractor leasing project will be profitable from the point of view of the society as a whole, as well as from the viewpoint of the owners and renters of the tractors. The approach to be used in this analysis is similar to the financial analysis which has been applied previously , that is employing the criteria of net present value (NPV), benefit-cost ratio (B/C ratio), and internal rate of return (IRR).

Generally, prices used to value benefits and costs are market prices. This is only satisfactory for financial analysis from the point of view of the tractor owners and renters. For the use of economic or social analysis some adjustment of prices is necessary, because market prices do not always reflect the competitive conditions premised to fulfil the Pareto-welfare optimum situation. This implies that market prices employed in the financial analysis may not reflect the true social value of goods and services to the economy, and that the costs or benefits of a particular item must be revalued in terms of its scarcity. These new prices are called shadow prices or accounting prices.

4.1. Shadow pricing benefit and cost

According to Gittinger (1972,p.39), in agricultural projects there are generally only three areas where the use of shadow prices should be considered rather than market prices. These are for foreign exchange, commodities which are important in the world market, and for unskilled labour.

4.1.1. Foreign exchange

Such adjustment for foreign exchange is called for when the official exchange rate does not reflect the scarcity value of foreign exchange; the adjustment could be downward or upward. Gittinger suggests that in shadow pricing foreign exchange, it is both simple and reasonable to use the rate of exchange which the Central Planning unit is using (Gittinger,1972,p.39). Other economists such as Chenery and Uzawa (1958,cited in Yalong 1977,p.72) suggest that the shadow price of foreign exchange is the equilibrium rate of the demand for and the supply of foreign exchange in the market. According to McCawley (1980,p.51), the real exchange rate can be determined using a formula :

$$\text{Real exchange rate} = \frac{Pt}{Pnt} = Pt^{*} \cdot r\frac{(1+t-s)}{Pnt}$$

where : Pt = domestic price of tradables

Pnt = domestic price of non-tradables

Pt^{*} = international price of tradables (say, in Singapore)

r = official exchange rate

t = tariff

s = subsidy

From the formula above, it is clear that the real exchange rate can be altered by :

a. a differential between the rate of inflation and that

$$\text{overseas, which will alter } \frac{P_t^*}{P_{nt}} \text{ , or}$$

b. a change in the official exchange rate, or

c. changes in the levels of tariff and subsidies, which will alter t and s

The situation in Indonesia is rather complex. "BAPPENAS" (National Planning Bureau) uses the official exchange rate for pricing foreign exchange, hence according to Gittinger's criterion, the official exchange rate is the shadow price of foreign exchange. This is understandable, since there is no black market of foreign exchange in Indonesia, so that there is no indication of the scarcity of foreign exchange. On the other hand many Indonesian economists, inside and outside the Government, suggest that the official exchange rate is overvalued, and thus needs to be devalued. This suggestion is based on the differential between the total inflation rates in Indonesia and her main trading partners overseas since 1971. That is why, on November 15,1978, the Government decided to devalue the official exchange rate by about 34 percent, that is from Rp 415. rationing to US$ 1.-, into Rp 625. However, the main reason for the government's devaluation of the official

exchange rate was to assist the non-oil tradable goods industries, such as rubber on the export side, and textiles on the import competing side (McCawley, 1980,p.47). Unfortunately, this Government decision caused many criticisms amongst economists who did not agree with devaluation. They argued, that based on the balance of trade situation, the official exchange rate Rp 415. per US$ 1. is undervalued, so it should be revalued instead of devalued (table 4.1.).

TABLE 4.1.

INDONESIAN BALANCE OF TRADE 1969-1979

(US $ million)

Year	Including oil			Increase
	Export	Import	Surplus	(%)
1969	854	781	73	-
1970	1,108	1,002	106	45
1971	1,234	1,103	131	24
1972	1,778	1,562	216	65
1973	3,211	2,729	482	123
1974	7,426	3,842	3,584	644
1975	7,102	4,770	2,332	-35
1976	8,547	5,673	2,874	23
1977	10,853	6,230	4,623	61
1978	11,643	6,690	4,953	7
1979	15,578	7,225	8,353	69

Source : IMF, International Financial Statistics, Jan.1977 and May 1980.

From the table it is obvious that between 1969 and 1979 the surplus of the balance of trade has increased. The highest increase, in 1974 (644%), was caused by the increase of the price of oil. However, in 1975 there was a decrease in the surplus of about 35 percent, which was caused by the Pertamina

(state oil enterprise) crisis. In 1978, the year when devaluation was decided, there was a surplus of Us $ 4,953 and in 1979 this surplus increased to US$ 8,353 or a 69 percent increase from the surplus in 1978. Thus, based on this fact, there are no reasons to devalue the official exchange rate. Since the study is not concerned with the problems of foreign exchange policy, to avoid debate on this matter, for the purpose of this study, and for simplicity, the shadow price of foreign exchange to be used are the official exchange rate before and after devaluation, that is Rp 415 and Rp 625 per US$ 1.

4.1.2. World market prices

A kind of shadow price which seems to make good sense in the analysis of agricultural projects is the use of world market prices instead of domestic market prices, particularly in a protected market like Indonesia. The reasoning here is that world markets more approximate perfect markets than protected markets. Thus the world market of rice (for example) is more nearly a true measure of the value of rice than a domestic market price.

Shadow prices of agricultural products should not be limited to crops which are intended for export. A measure of the worth of an investment to a country may be obtained by shadow pricing the output of an agricultural commodity to be produced in the project rather than by using domestic prices, even if the commodity is expected to be largely consumed (Gittinger 1972,p.40).

The approach to be used here is to use fob prices plus the cost of freight and insurance, or cif prices for the imported goods, plus other costs if any, except taxes. Thus in the case of tractors, since they are imported by private enterprise, the domestic market price is determined by the cif price of tractors plus taxes plus other costs (appendix 3.3.), and the shadow price of tractors is determined by the cif price plus other costs only. For fuel, lubricating oil, and rice , since they are imported by the state enterprise, the prices of these commodities are determined by the cif price plus taxes or minus subsidies, then the shadow prices of these commodities are determined by their cif price only. Thus for a commodity which is subsidized (fuel and rice) the shadow price will be higher than the domestic market price. On the other hand, a commodity which is taxed (lubricating oil), will have a lower shadow price. As long as the shadow price of foreign exchange is correct, this would not introduce a bias into the analysis.

4.1.3. Labour

The price of labour in a perfectly competitive market would be determined by the marginal value product of the labour, that is, the wage would be equal to that amount of product which an extra labourer hired would produce. The problem arises in the less developed countries (LDCs) in which there is a surplus of labour in the agricultural sector and a shortage of labour in the urban-industrial sector. Therefore the marginal value product of labour in the agricultural sector would be zero or close to zero, while in the industrial sector it would be very high (Lewis,1954,pp.141-2). Schultz

(1964,pp.53-70) argued that though the marginal value of agricultural product in less developed countries is indeed very low, it is significantly greater than zero. Gittinger suggests (1972,p.42) that in a community where the agricultural employment is very seasonal,such as in a rice producing country, that during a certain times for example land preparation, transplanting, and harvesting, farmers may not be able to hire enough labour to bring in their crop as fast as they would like to. Thus, in these circumstances, virtually every agricultural labourer can find employment at the peak season, and casual labourers from urban areas may return to their home villages to be involved in these activities. Surely, at these peak times, the marginal value product of agricultural labour is not zero. Thus, in agricultural project analysis it would seem reasonable to suggest that the price of labour at this time can be valued on an annual basis at a price which is determined by multiplying the wage when labour is scarce by the number of days in a year when it can be considered that labour is reasonably fully employed. On the other hand, while the value of unskilled agricultural labour may reasonably be shadow priced below the going wage rate, skilled labour probably should not be. In most cases, skilled labour is quite scarce and thus should be shadow priced at a level above its wage to reflect its scarcity.

Since the labour involved in this study (particularly for this analysis) is the operator of the tractor, which must be a skilled labourer or at least semi-skilled, thus, his wage is assumed to reflect his scarcity. Hence, the wage of the operator is also taken as the shadow price of labour.

Another thing that must be considered before economic analysis can be undertaken is the price of investment. As mentioned earlier , the prices of investment used in the earlier financial analysis ranged from 12 to 24 percent per annum (see sensitivity analysis). As compared with this and as mentioned before, Gittinger suggests that the discount rate attached to future returns by society as a whole should be different from that which an individual would use. Normally, it is felt that society has a longer time horizon than the individual, so that its discount rate should be lower. He said that a discount rate of 12 percent is a popular choice (Gittinger, 1972). Rajino (1973), as mentioned earlier, also assumed a 12 percent discount rate in his study. His assumption was based on the lending interest of World Bank loans approved under international aid schemes to Indonesia. Therefore, for the purpose of this study, a discount rate of 12 percent is considered reasonable to be used for the economic analysis; this puts the rate used in the economic analysis at the bottom end of the range used for financial analysis.

4.2. Economic analysis.

In this section a social cost-benefit analysis will be prepared from the point of view of the society as a whole. Data used in this analysis will be based on the data used for financial analysis. The difference is that the cash flow will use shadow prices instead of market prices. Calculating the benefit of mechanization projects at economic prices has to be done in terms of additional crop production as a result of mechanization. For instance, the benefit of mechanized "sawah"

cultivation is the higher paddy yield per hectare at the economic price of rice. The benefits of mechanization should not be considered in terms of saving labour, because the opportunity cost of rural workers might be nil (Rijk 1979,p.101). Thus, the benefit of the project will be calculated from the value of the expected increase in production per season as a result of the introduction of hand-tractors for land preparation. As mentioned earlier, the use of hand-tractors for land preparation could increase the productivity of land in terms of cropping intensity. Using the "standard" IBRD assumption, mentioned earlier (chap.1), the use of tractors for land preparation will increase the cropping intensity by at least 20 percent, and if we assume that the average yield per hectare is 4 tons of rough rice (table 1.8), an increase in cropping intensity by 20 percent implies an addition of 0.8 ton per ha of rough rice annually. The 0.8 ton rough rice is then converted into a value of milled rice. No fixed rates are really applicable since the conversion depends so critically on the quality of rough rice, moisture content, variety, by-product rates etc, and the most important factor is the way the rough rice is milled. Timmer (1973,pp.65-67) suggests the average conversion rate (rendement) of rough rice into milled rice according to the equipment used for milling, as follows (table 4.2).

TABLE 4.2.

AVERAGE CONVERSION RATE OF ROUGH RICE INTO MILLED RICE ACCORDING TO THE EQUIPMENT USED FOR MILLING

No.	Method of milling	Rendement (%)
1.	Hand pounding	57
2.	Small Rice Mill	59
3.	Large Rice Mill	63
4.	Small Bulk Facility	65
5.	Large Bulk Facility	67

Source : Timmer (1973)

For the purpose of this study, an assumption of a conversion rate (rendement) of rough rice into milled rice of 60 percent is taken as reasonable.

Though Bali is a rice surplus province, to meet the need for rice for the Indonesian population, the Government always imports rice from year to year. In Indonesia, rice is graded into high, medium, and low quality. This quality grading is based on the percentage of broken rice and the flavour as well. Generally, the local variety of rice, because it is tasty is classified as high quality, and the high yielding variety (HYV), although it gives a higher production than the local one, is not as tasty, so is classified as low quality. The imported rice generally is classified as medium quality. The difference in quality implies a difference in price. In a certain area, such as Yogyakarta, if the price index of the

medium quality imported rice is 100, then the price index of the high (low) quality will range about 10 to 20 percent higher (lower). Rice farmers in Bali, generally, are intensive farmers, as we can see in table 1.10. From table 1.10, it is obvious that the rice intensification area has increased from 18 percent of the total "sawah" in Bali in 1969, to 72 percent in 1974. In table 1.11, we can also see that more than 50 percent of the farmers in the study area are intensive farmers. This suggests that they planted HYV to get a higher production in addition to the use of fertilizer and other new technological inputs. For the purpose of this study, in shadow pricing the benefit of the project, the price of the rice produced is assumed to be 80 percent of the world price of the imported rice.

Thus, data used for the economic analysis can be presented as follows (table 4.3) :

TABLE 4.3.

DATA USED FOR ECONOMIC ANALYSIS

No.	Items	Unit	Shadow price of foreign exch. US$ 1=Rp415	Shadow price of foreign exch. US$ 1=Rp625
1.	Price of tractor[1)]	Rp	849,792	1,237,998
2.	Area cultivated per season	ha	18	18
3.	Operating cost per hectare:			
	a. Fuel[1)]	Rp	1,050	1,575
	b. Lubricating oil[1)]	Rp	272	410
	c. Operator wage	Rp	4,615	4,615
	d. Maintenance cost[1)]	Rp	2,038	2,971
4.	Economic life of tractor	year	5	5
5.	Benefit[1)] per heactare per season	Rp	22,908	34,500

Note : For calculation,see appendices 4.1. to 4.5.

TABLE 4.4.

ECONOMIC ANALYSIS BASED ON THE SHADOW PRICE OF FOREIGN EXCHANGE Rp 415 AND Rp 625 FOR US$ 1

Criteria	Shadow price of foreign exchange US$ 1 = Rp 415	Shadow price of foreign exchange US$ 1 = Rp 625
1. NPV	Rp 1,168,000	Rp 2,137,000
2. B/C	1.6	1.85
3. IRR	62%	69%

Note : For calculation, see appendices 4.6. & 4.7.

Based on the data presented above and assuming the economic life of the tractor to be 5 years, an interest rate of 12 percent per annum, and a salvage value of the tractor of 10 percent, using the criteria of NPV,B/C, and IRR an economic analysis based on shadow prices of foreign exchange of Rp 415 and Rp 625 per US$ 1 , are as shown in table 4.4. It can be seen that the analysis give a satisfactory value of NPV, B/C ratio, and IRR, based on a shadow price of foreign exchange of Rp 415 for US$ 1 , as well as Rp 625. Thus, it is obvious that from the point of view of society as a whole, a leasing hand-tractor project is economically profitable, as long as the assumptions used in the analysis are accepted.

As mentioned previously, this analysis is based on the assumption that the introduction of tractors could increase the cropping intensity by at least 20 percent (IBRD "standard"). This assumption is chosen, because there are no specific studies, on this matter, in Indonesia. A study in South Sulawesi reported that the introduction of mini-tractors (12-15 HP) increased the cropping intensity between 14 and 27 percent (Agricultural Extension Office, Kabupaten Sidrap, cited in Department of Agriculture, 1978), the average is around 20 percent, similar to the IBRD "standard" which is used in this study. Based on the study in South Sulawesi above, it is better if analysis is also done based on the assumption that the introduction of tractors could increase the cropping intensity by 14 percent (the minimum increase in cropping intensity). Then, by using a trial and error method, that is by employing assumptions of various levels (percentage) of increase in cropping intensity as a result of the introduction

of tractors for land preparation, analysis will also be done. The aim of this sensitivity analysis is to examine at what level of increase in cropping intensity the introduction of tractors is economically profitable from the point of view of society. Except for the change in the measure of the benefit of the introduction of tractor per hectare, the data used for this analysis is the same as used in the analysis before. The benefits of the introduction of tractors for land preparation per hectare according to various assumptions about the levels of increase in cropping intensity (and based on the shadow prices of foreign exchange of Rp 415 and Rp 625 for US$ 1 are as follows (table 4.5.):

TABLE 4.5.

THE BENEFIT OF INTRODUCING HAND TRACTORS FOR LAND PREPARATION BY VARIOUS INCREASE IN CROPPING INTENSITY(ICI)

No.	Various ICI (%)	Benefit per hectare (Rp)	
		US$ 1 = Rp 415	US$ 1 = Rp 625
1.	20	22,908	34,500
2.	14	16,036	24,150
3.	13	14,890	22,425
4.	12	13,745	20,700
5.	11	12,599	18,975
6.	10	11,454	17,250

Based on the assumptions of the economic life of the tractor being 5 years; salvage value being 10 percent; and interest rate being 12 percent per year; and based on the various benefits of the introduction of tractors as presented above, the economic analysis (based on a shadow price of foreign

exchange of Rp 415 and Rp 625 for US$ 1) is shown in table 4.6.

TABLE 4.6.

ECONOMIC ANALYSIS BY VARIOUS INCREASE IN CROPPING INTENSITY

NO.	ICI (%)	Shadow price of foreign exchange					
		US$ 1 = Rp 415			US$ 1 = Rp 625		
		NPV (Rp1000)	B/C	IRR (%)	NPV (Rp1,000)	B/C	IRR (%)
1.	14	264	1.14	24	766	1.3	35
2.	13	100	1.06	16	538	1.2	29
3.	12	- 45	0.98	10	310	1.12	22
4.	11	-	-	-	82	1.03	15
5.	10	-	-	-	-146	0.94	7

Note : For calculation, see appendices 4.8. to 4.15.

From the table, we can see that if the cropping intensity increases by 14 percent, as a result of the introduction of tractors, economically the introduction of tractors is profitable from the point of view of the society, whether based on a shadow price of foreign exchange of Rp 415 or Rp 625 for US$ 1. Then if we examine further, based on a shadow price of foreign exchange of Rp 415 for US$ 1, at a level of increase in cropping intensity of 13 percent, the introduction of tractors is profitable, but at a level of increase in cropping intensity of 12 percent the introduction of tractors is economically unprofitable from the point of view of the society. On the other hand, based on a shadow price of foreign exchange of Rp 625 for US$ 1, the introduction of tractors is economically profitable at a level of increase in cropping intensity of 11

percent, but at a level of increase in cropping intensity of 10 percent the introduction of tractors will be economically unprofitable from the point of view of the society.

From the discussion above, it can be concluded that the introduction of tractors for land preparation will be economically profitable from the point of view of society as a whole, based on a shadow price of foreign exchange of Rp 415 for US$ 1, if it can increase the cropping intensity by at least 13 percent; and based on the shadow price of foreign exchange Rp 625 per US$ 1, if it can increase the cropping intensity by at least 11 percent.

4.3. The impact of the project on employment potentialities

As mentioned previously, the benefit of the project for the economic analysis is based on the assumption that the implementation of hand-tractors for land preparation increases the productivity of land in terms of cropping intensity; and based on the assumption of the IBRD "standard" that the increase of cropping intensity is at least 20 percent per year. An increase of cropping intensity by 20 percent results in an increase in farming activity of 20 percent as well. In line with this assumption, an increase of farming activity of 20 percent will also cause an increase in labour requirement for farming activity, (except for land preparation which is assumed to be done by tractors), such as for sowing, weeding, harvesting, transportation and milling. Thus, the introduction of tractors causes greater use of labour rather than labour displacement. Another gain to society in accordance with the impact of the project on employment potentialities is the

opportunity of the society to establish kiosks providing fuel, lubricating oil, and maybe small parts for tractors, since the tractor dealers have the responsibility of providing spare parts for tractors which they have sold.

From the discussion above, it seems that the introduction of tractors for land preparation will be profitable from the point of view of society as a whole. Since, generally, farmers are short of funds to buy tractors, the introduction of tractors in the form of a leasing project is preferable. The only problem is that it is necessary to show that there is a labour shortage to justify the introduction of tractors in Indonesia. Is it time to introduce tractors to Bali ?

As explained earlier, the Department of Agriculture concluded in its study that there was a problem of a shortage of power for land cultivation in the study area. This conclusion is based on the analysis as presented in table 3.1. It was also reported that according to the Department of Agriculture, the cultivation period per season in Bali is determined by an empirical calculation based on the past cultivation period which has been employed for hundreds of years. By implementing the "kerta masa" system, it is hoped that farmers in a "subak" can plant simultaneously using the same HYV of seed, so that the risk of damage caused by the explosion of plant pests and disease could be reduced. By this method, each "subak" decides the cultivation period for the "sawah" under this "subak", and the cultivation period is ranged between 15 and 21 days. If a "subak" member ignores this advice and is late to plant, he gets a penalty from the "subak" leader. That is why, by implementing the "kerta masa"

system, the problem of a shortage of agricultural power would obviously arise in Kabupaten Badung, Tabanan, and Gianyar.

SAE in its analysis of the effects of the introduction of hand-tractors in Bali on employment opportunity, based its data on the interviews conducted during the survey, and secondary data from the local office of the Department of Agriculture, and Animal Husbandry. It was reported, by SAE, that based only on this data, it is difficult to make an analysis of employment problems. So far, from the interview data, farmers (land holders) and labourers give conflicting information. On one side, the farmers said that they had difficulty in getting agricultural labour for land cultivation, and on the other side the labourers said that they had difficulty in getting jobs. Other obstacles in analysing employment problem based on the statistical data (secondary data), is the fact that the data available is 'stock data' (i.e. total population and labour force, and total animals in a region for a certain period), and data needed for the analysis is the 'flow data' (i.e. total work days available and needed in a region at a certain time), and the most important thing is the accuracy of the data itself. However, by converting the data available into an indirect indicator and by using many assumptions, SAE concluded in its study, that there was no evidence of a shortage of power (human labour and draft animals) in the study area as presented in table 4.7. From the table, we can see that mostly in the sample villages, there was a surplus of agricultural power. However in Krobokan Kabupaten Badung, there was a deficit of power (human labour and draft animal) during the wet and dry season; in Pemecutan Kabupaten Badung, there was a deficit of

draft animals during the wet and dry seasons; in Timpag Kabupaten Tabanan there was a deficit of human labour in the wet and dry seasons; in Bengkel Kabupaten Tabanan, there was a deficit of human labour in the dry season; and in Sembung Gde Kabupaten Tabanan, there was a deficit of agricultural power during the dry season. Because of the mobility of the agricultural power (human labour and draft animal), the deficit villages can be supplemented by the surplus villages.

If we look further at column 'cultivation period per season', it is obvious that the data presented above is the data of supply and demand of power for land cultivation in sample villages (1976) when the "tulak sumur" system is implemented. When the "kerta masa" system is implemented, in which the cultivation period per season is only between 15 and 21 days, the situation is different (table 4.8.).

TABLE 4.7.

SUPPLY AND DEMAND ANALYSIS OF POWER FOR LAND CULTIVATION IN SAMPLE VILLAGES (1976)

Sample villages/ Kabupatens	Supply of power		Total Acreage	Cultivation period		Demand for power				Supply of power				Balance				Balance			
						Wet season		Dry season		Wet Season		Dry season		Wet season		Dry season		Wet season		Dry season	
	Animal (pair)	Human (person)	(ha)	W.S. (wd)	D.S. (wd)	Animal (wd)	Human (wd)	Animal (wd)	Human (wd)	Animal a) (wd)	Human b) (wd)	Animal c) (wd)	Human d) (wd)	Animal e) (wd)	Human f) (wd)	Animal g) (wd)	Human h) (wd)	Animal i) (%)	Human j) (%)	Animal k) (%)	Human l) (%)
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
I. KAB. BADUNG																					
1. Peguyangan	230.4	573.6	703	40	40	8,436	12,443	8,436	12,443	9,216	22,944	9,216	22,944	780	10,501	780	10,501	9	84	9	84
2. Krobokan	176.4	720.5	1,158	35	35	11,580	61,258	11,580	61,258	6,174	25,218	6,174	25,218	-5,406	-36,040	-5,406	-36,040	-47	-59	-47	-59
3. Pemecutan	71.4	1,433.5	718	40	40	7,898	30,946	7,898	30,946	2,856	57,340	2,856	57,340	-5,042	26,394	-5,042	26,394	-64	85	-64	85
II. KAB. TABANAN																					
1. Timpag	443.4	301.7	346.2	35	21	1,385	16,645	1,385	16,645	15,522	10,560	9,311	6,336	14,137	-6,086	793	-10,311	1,021	-37	572	-62
2. Bengkel	94.8	176.1	186.7	75	30	840	8,868	840	8,868	7,110	13,208	2,844	5,286	6,270	4,340	2,004	-3,585	764	49	239	-40
3. Sembung Gde	252.6	305	378	70	30	9,072	18,144	9,072	18,144	17,682	21,350	7,578	9,150	8,610	3,206	-1,494	-8,994	95	18	-16	-50
III. KAB. GIANYAR																					
1. Singapadu	433.8	993.9	886	60	45	15,948	22,150	15,948	22,150	26,028	59,634	19,521	44,726	10,080	37,484	3,573	22,576	63	169	22	101
2. Pering	464.4	480	418	45	45	5,852	7,942	5,852	7,942	20,880	21,600	20,880	21,600	15,028	13,658	15,028	13,658	257	172	257	172
3. Ketewel	400.2	668.4	336	45	30	6,720	8,064	6,720	8,064	18,009	30,078	12,006	20,052	11,289	22,014	5,286	11,988	168	273	79	149

Source : Sinaga et al., (1977, opcit)

Notes : W.S. : wet season
W.D. : dry season
wd : workdays

a) 1 x 4 ; d) 2 x 5 ; g) 12 - 8 ; j) 15/7
b) 2 x 4 ; e) 10 - 6 ; h) 13 - 9 ; k) 16/8
c) 1 x 5 ; f) 11 - 7 ; i) 14/6 ; l) 17/9

TABLE 4.8.

SUPPLY AND DEMAND ANALYSIS OF POWER FOR LAND CULTIVATION IN SAMPLE VILLAGES (1976)

Sample villages/ Kabupatens	Supply of power		Total	Cultivation	Demand of power		Supply of power		Balance		Balance	
	Animal (pair)	Human (person)	Acreage (ha)	Period (wd)	Animal (wd)	Human	Animal a)	Human (wd) b)	Animal c)	Human (wd) d)	Animal e)	Human (%) f)
	1	2	3	4	5	6	7	8	9	10	11	12
I. KAB. BADUNG												
1. Peguyangan	230.4	573.6	703	21	8,436	12,443	4,838	12,046	- 3,598	- 397	- 43	- 3
2. Krobokan	176.4	730.5	1,158	21	11,580	61,258	3,704	15,131	- 7,876	-46,127	- 68	- 75
3. Pemecutan	71.4	1,433.5	718	21	7,898	30,946	1,499	30,104	- 6,399	- 842	- 81	- 3
II. KAB. TABANAN												
1. Timpag	443.4	301.7	346.2	21	1,385	16,646	9,311	6,336	7,927	-10,310	572	- 62
2. Bengkel	94.8	176.1	186.7	21	840	8,868	1,991	3,698	1,151	- 5,170	137	- 58
3. Sembung Gde	252.6	305	378	21	9,072	18,144	5,305	6,405	- 3,767	-11,739	- 42	- 65
III. KAB. GIANYAR												
1. Singapadu	433.8	993.9	886	21	15,948	22,150	9,110	20,872	- 6,838	- 1,278	- 75	- 6
2. Pering	464.4	480	418	21	5,852	7,942	9,752	10,080	3,900	2,123	67	27
3. Ketewel	400.2	668.4	336	21	6,730	8,064	8,404	14,036	1,684	5,972	25	74

Source : derived from table 4.7.

Assumption : Cultivation period when "kerta masa" system is implemented, during wet and dry season are the same (21 days)

Notes : wd : work days ; a) 1 x 4 ; c) 7 - 5 ; e) 9/5

b) 2 x 4 ; d) 8 - 6 ; f) 10/6

From the table it is clear that if the "kerta masa" system is implemented, and we assume that the cultivation period per season is 21 days whether during the wet season or dry season as well, there will be a deficit of agricultural power mostly in the sample villages. However in Pering and Ketewel Kabupaten Gianyar, there is a surplus of agricultural power during the wet and dry seasons; and in Timpag and Bengkel Kabupaten Tabanan there is a surplus of draft animals during the wet and dry seasons. It is obvious that even this agricultural power (human labour and draft animals) is mobile, but the surplus could not be enough to supplement the deficit, thus the problem of a shortage of agricultural power still exists.

As a matter of fact, at present hand-tractors or power tillers are used in some regions in Java and Bali, although there are many reactions against the introduction of tractors or power-tillers in this area, because the people are worried that the introduction of hand-tractors will cause a problem of unemployment, as reported by the Faculty of Agricultural Technology (Purwadi et al,1979) as shown in table 4.9 following:

TABLE 4.9.

NUMBER OF TRACTOR IN JAVA AND BALI (1977)

No.	Province	2-Wheel	4-Wheel
1.	West Java	662	463
2.	Central Java	550	51
3.	East Java	263	176
4.	Bali	268	3

Source : Reports from the Local Office of the Department of Agriculture in each province, cited in Purwadi et al., (1979)

From table 4.9, it can be suggested that in some areas in Java and Bali there are indications of shortages of power in the agricultural sector, particularly for land cultivation. This problem will be more obvious if we look further at the distribution of the tractors in each province we may find that they are unequally distibuted in all Kabupaten, and it might be that they are also unequally distributed in all Kecamatan within the Kabupaten as well. This situation suggests that the distribution of power in the agricultural sector in Java and Bali is also not equal. Thus there is some regions a surplus of agricultural power, while in other regions there is a shortage. Because of this inequality, support for or disapproval of the introduction of tractors for land cultivation in some regions in Java and Bali corresponds to the supply of agricultural power.

In this matter, ESCAP reported (Rijk 1979,p.10) that in Karawang West Java and generally in irrigated areas, it is difficult to get power (human labour and draft animal), particularly for land cultivation for the secondary rice crop in this area. The problem exists because land preparation must be done quickly to catch the irrigation schedule. At the same time, most labourers are still working on harvesting the first rice crop and they prefer working on harvesting, rather than hoeing or ploughing because the wage rate is higher (14). It is also reported that the most important feature of the Indonesian employment development during recent years is the shift from agricultural to non-agrcultural activities. Although the total number of rural workers employed in agriculture have increased, the employment in non-agricultural activities in rural areas has grown 2 or 3 times more rapidly. According to an IBRD report, the rapid rise in agricultural production and incomes during 1971 - 76 enabled an increasing proportion of rural labour to find sources of income and employment outside the agricultural sector where the labour demand increased as a result of higher agricultural income (Rijk 1979,p.82).

From the discussion above, it is clear that, although Java and Bali are known as the most densely populated islands in Indonesia, there are indications of a shortage of agricultural power in some regions particularly for land cultivation and in

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(14) In this area the wages for harvesting are paid in kind and vary between 15-25% of the yield.

irrigated areas. It is suggested that this problem is caused by the unequal distribution of the supply and demand for power (human labour and draft animals) between regions and because of the completion of some irrigation projects. In Bali the problem has become more serious due to the implementation of the "kerta masa" system in which the cultivation period per season is limited.

CHAPTER 5

SUMMARY AND CONCLUSION

5.1. Summary

Through the introduction of hand-tractors, particularly for land preparation, it is anticipated that the productivity of labour and land (in terms of cropping intensity) will increase, and that total output will therefore also increase. However, the introduction of hand-tractors sometimes causes labour displacement, which leads to unemployment and related problems in a labour surplus country like Indonesia.

Though Indonesia is regarded as having a surplus of labour, particularly in Java and Bali, there are indications of shortages of power (human labour and draft animal) for land preparation, especially at peak seasons and more specifically in the irrigated areas. The specific problem in Bali is that in order to avoid the production losses due to insects, pests, and diseases (recently the most dangerous is "wereng"), the "kerta masa" system, which is being coordinated by "subak" is to be implemented. By implementing this system, all farming activities in "sawah" under the "subak", such as land preparation, sowing, weeding, spraying, and harvesting, are done simultaneously and in a limited time span per season. Thus there is a greater seasonal variation demand for labour, and there is a need to overcome the problem of the lack of

human labour and draft animals.

To alleviate the problem of shortages of power for land preparation, hand-tractors or power-tillers could be introduced. Since most farmers are short of funds, the introduction of hand-tractors would be in the form of a leasing project.

This study deals with an economic evaluation of a hand-tractor leasing project in Indonesia, with a case study in Kabupaten Badung, Gianyar, and Tabanan, in the province of Bali. The first objective of the study was to analyse whether the operation of the hand-tractor leasing project in these areas was profitable from the point of view of the tractor owner, tractor renter, and the society as a whole. The second objective of the study was to analyse the impact of the leasing hand-tractor project on employment potentialities in the study area; the question being asked is whether the introduction of hand-tractors causes labour displacement or creates employment.

The data used in this study are derived mainly from the previous studies done by the Sub-Directorate of Agricultural Mechanization Department of Agriculture (1976) and Team Survey of Rural Dynamics Studies of the Agro Economic Survey (1977). Cost-benefit analysis was employed to analyse the operation of the hand-tractor leasing project, and the criteria used were the net present value (NPV), benefit-cost ratio (B/C ratio), and internal rate of return (IRR).

The data used for financial cost-benefit analysis from the point of view of the tractor owner is as follows (table 5.1)

TABLE 5.1.

DATA USED FOR FINANCIAL COST BENEFIT ANALYSIS

No.	Items	Unit	Assumptions			
			I a)	II b)	III c)	IV d)
1.	Price of tractor	Rp (million)	1.3	1.3	1.212	1.212
2.	Capacity of tractor per hectare	hrs	20	20	20	20
3.	Area cultivated by tractor per season	ha	18	18	40	18
4.	Operating cost per hectare	Rp	9,125	9,125	9,875	9,875
5.	Rental fee of tractor per hectare	Rp	19,800	20,667	19,766	19,766
6.	Economic life of tractor	hrs	3,600	2,160	4,800	3,600
		(years)	(5)	(3)	(3)	(5)
7.	Salvage value	%	10	46	10	10

Notes : a) Assumption mainly used in this study (economic life of tractor 5 years)

b) Assumption mainly used in this study, if economic life of tractor is 3 years

c) Assumption based on the proposal of the hand-tractor leasing project (economic life of tractor 3 years)

d) Assumption based on the proposal of the hand-tractor leasing project, if economic life of tractor is 5 years.

The findings of the financial cost-benefit analysis from the point of view of tractor owners are :

No.	Criteria	unit	Assumptions			
			I a)	II b)	III c)	IV d)
1.	NPV	Rp	184,000	143,000	818,000	167,000
2.	B/C		1.07	1.07	1.76	1.07
3.	IRR	%	17.8	17.6	49	17.6

Note : a), b), c), and d) see note table 5.1.

Based on the three criteria of NPV, B/C ratio, and IRR, the project was found to be financially profitable from the point of view of the tractor owner.

From the point of view of the tractor renter, the financial benefit is calculated from the saving of the tractor renter as a result of the difference between cultivation costs when a hand-tractor is used and costs when traditional methods are used. The findings of this analysis are as follows (table 5.2.):

TABLE 5.2.

SAVINGS IN CULTIVATION COST PER HECTARE WHEN A TRACTOR IS USED, WITH AND WITHOUT EXTRA COST [1)]

No.	Methods	With extra cost		Without extra cost	
		Rp	%	Rp	%
1.	Compare to human labour	4,520	18	9,275	47
2.	Compare to draft animal	445	2	5,200	26
3.	Compare to combination human labour & draft animal	3,806	15	8,561	43

Note : 1) extra cost is cost for extra work, that is work done by human labour to complete land preparation done by tractor.

From these figures it is clear that farmers tend to hire tractors because they are cheaper than the traditional cultivation methods, and because the tractors make it easier to meet the "subak" schedule for irrigation and planting deadlines in order to implement the "kerta masa" system. The lower cost of using hand-tractors is due to some subsidies (direct and indirect) from the government in terms of low interest rates, low import taxes, and the pegging of the rupiah-dollar exchange rate.

To examine the effects of these subsidies on tractor prices, tractor costs per year, rental fees per hectare, income per year, annual profit or loss, and the cultivation cost per hectare, a sensitivity analysis was conducted. Based on the sensitivity analysis, at a constant rental fee of Rp 19,800 per

hectare, the project is financially profitable from the point of view of both the tractor owner and renter, on the assumption that the exchange rate is Rp 415 per US$ 1 , that the interest rate is 12 percent per annum, and that the import tax is 50 percent cif. If the rental fee can be adjusted, as long as the rental fee is less than the cultivation cost by traditional methods, the project is financially profitable from the point of view of both the tractor owner and renter at an interest rate of 12 percent per annum, and at import tax rates of up to 75 percent cif. When the exchange rate is Rp 625 for US$ 1 (after devaluation), whether the rental fee is constant or adjusted, the project will be financially unprofitable. However, if the rental fee can be adjusted, the owner will make a profit, but the constraint is the cultivation costs of the traditional methods: if the the rental fee exceed the cultivation cost by traditional methods, farmers will be reluctant to hire hand-tractors.

The economic analysis from the point of view of society as a whole, assuming a 20 percent increase in cropping intensity as a result of the introduction of tractors, and using a shadow price of foreign exchange of either Rp 415 or Rp 625 to US$ 1, showed that the project is economically profitable. Further analysis showed that the introduction of tractors, particularly for land preparation, is economically profitable if it can increase the cropping intensity by at least 13 percent (based on a shadow price of foreign exchange Rp 415 for US$ 1) or at least 11 percent (based on the shadow price of foreign exchange Rp 625 for US $1).

As mentioned above, the gain to society is based on the increase in cropping intensity as a result of the introduction of hand-tractors or power-tillers. The increase in cropping intensity will also increase farming activities, thus there will be an increase in the demand for labour for farming activities (except for land preparation which is assumed to be done by tractor,) such as sowing, weeding, spraying, and harvesting, transportation, and milling. Thus, the introduction of tractors could actually create employment rather than displace labour. Another gain to the society is that there would be additional opportunities to establish kiosks providing fuel, lubricating oil, small repair shops, transportation and milling, and so on which also create employment opportunities.

Further analysis indicated that by comparing the supply of power and the demand for power at the village level in the study area, it is clear that if the "kerta masa" system, in which the cultivation period is between 15 and 21 days per season, is implemented a problem of shortage of power, particularly for land preparation, will arise. Under these conditions the introduction of hand-tractors or power-tillers as an alternative to supplementing the shortage of power, will be justified.

5.2. Conclusion

From the discussion above, it can be concluded that in order to avoid the failure of harvesting a rice crop as a result of the explosion of insects, pests and diseases, farmers have to plant simultaneously in addition to using the resistant

varieties. In Bali, this system is known as "kerta-masa". An obstacle, when the "kerta-masa" system is implemented, is the limited cultivation period per season (between 15 and 21 days), as compared to the cultivation period per season when the "tulak sumur" system is implemented (between 21 and 75 days). One way of overcoming this obstacle is by introducing hand-tractors or power-tillers. As long as the assumptions used in this study hold, the introduction of hand-tractors or power-tillers in Kabupaten Badung, Gianyar, and Tabanan the province of Bali, will be profitable from the point of view of society as a whole.

It must be stressed that the analysis undertaken in this study was based on the data for a specified period and for a specified province. The analysis was thus static and the findings are only applicable if it can be shown that conditions prevailing at present are the same as those that shaped the data in this study. Many factors may have changed : for example, the price of the tractor, the price of fuel and lubricating oil, the wage rate of labour, and so on. Thus the findings of this study cannot be used as a general consideration for the policy maker in order to introduce hand-tractors in the form of a leasing project in Indonesia. However, the general policy implication of this study is that the introduction of hand-tractors or power-tillers must be selective. The introduction of hand-tractors should fit in with a region's economic, employment, production, and cultural needs.

To provide information on what specific actions economically and socially justify the introduction of tractors in Indonesia, further studies would be valuable. These studies must be conducted in other regions (provinces), and should be inter-diciplinary studies, which involve agronomists, agricultural engineers, agricultural economists, sociologists and so on. Since these studies should be conducted at the village level, the involvement of farmers (land holders) and labourers (farm workers) would be highly desirable.

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A P P E N D I C E S

Assumptions : economic life of tractor 7 years; salvage value 10%; interest rate 12% per year

(Rp '000)

Season	K	C	B	DF 6%[a]	PVC	PVB	DF 10%[b]	PVC	PVB	DF 15%[b]	PVC	PVB
0	1,300			1	1,300		1	1,300		1	1,300	
1		135	321	.943	127	303	.909	123	292	.870	117	279
2		135	321	.890	120	286	.826	112	265	.756	102	243
3		135	321	.840	113	270	.751	102	241	.658	89	211
4		135	321	.792	107	254	.683	92	219	.572	77	184
5		135	321	.747	101	240	.621	84	199	.497	67	160
6		135	321	.705	95	226	.564	76	181	.432	58	137
7		135	321	.665	90	213	.513	69	165	.376	51	121
8		135	321	.627	85	201	.467	63	150	.327	44	105
9		135	321	.591	80	190	.424	57	136	.284	38	91
10		135	321	.558	75	179	.386	52	124	.247	33	79
11		135	321	.527	71	169	.350	47	112	.215	29	69
12		135	321	.497	67	160	.319	43	102	.187	25	60
13		135	321	.469	63	151	.290	39	93	.163	22	52
14		135	451	.442	60	199	.263	36	119	.141	19	64
					2,554	3,040		2,295	2,398		2,073	1,856

Notes : Numbers for calculation are rounded in thousand
a) As calculation is on seasonal basis, the discount rate used is 6% instead of 12%
b) Discount factor 10 and 15 percent only use for calculating IRR

Results : 1) NPV = Rp 3,040,000 - Rp 2,554,000 = Rp 486,000
2) B/C = Rp 3,040,000/Rp 2,554,000 = 1.19
3) IRR = (.10 + 103 x .05/320) x 2 = 23%

Assumptions : economic life of tractor 3 years; salvage value 10%; interest 12% per year

(Rp '000)

Season	K	C	B	DF 6% [a]	PVC	PVB	DF 2% [b]	PVC	PVB
0	1,181			1	1,181		1	1,181	
1		155	342	.943	146	322	.980	152	335
2		155	342	.890	138	304	.961	149	328
3		155	342	.840	130	287	.942	146	322
4		155	342	.792	122	271	.924	143	316
5		155	342	.747	115	255	.906	140	310
6		155	460	.705	109	324	.888	137	408
					1,941	1,763		2,048	2,019

Notes : Numbers for calculation are rounded in thousands

a) As calculation is on seasonal basis, the discount rate used is 6% instead of 12%

b) Discount factor 2% only use for calculating IRR

Results : 1) NPV = Rp 1,763,000 - Rp 1,941,000 = -Rp 178,000

2) B/C = Rp 1,763,000 / Rp 1,941,000 = 0.91

3) IRR = (.06 - 178 x .04/149) x 2 = 2.4%

Appendix 3.3. : Price of tractor (Satoh Power Tiller K-170),7-7.5HP in 1977 (before devaluation)

Price of tractor c&f = US$ 1,507.59

C & F price= US$ 1,507.59 x Rp 415		= Rp 625,650
Insurance : .5% c&f		= Rp 3,128
	CIF Price	= Rp 628,778
Import tax : 20% cif	= Rp 125,756	
MPO import : Rp 38/US$ 1	= Rp 57,288	
Warehouse : 15% cif	= Rp 93,848	
Sale tax : 10% cif	= Rp 62,878	
Other cost : 1.2% c&f	= Rp 7,508	
		= Rp 347,278
	Sub-total	= Rp 976,741
Agent comission : 5% cif		= Rp 31,439
	Sub-total	= Rp 1,008,180
Importer (sole distribution) profit : 15%		= Rp 151,227
	Sub-total	= Rp 1,159,407
Sale tax : 5%		= Rp 57,227
	Price in Jakarta	= Rp 1,217,377

Notes : 1) Other costs include : cable : 0.1% c&f
Bank : 0.5% c&f
Stamp cost : 0.1% c&f
Document provision : 0.5% c&f

2) Price of tractor in Bali = Rp 1,300,000

The difference of price of tractor in Jakarta and in Bali can be assumed as transportation cost, that is Rp 82,623.

Source : P.T. Indokaya, Jakarta 28/3/79

Appendix 3.4. : Financial cost-benefit analysis from the point of view of tractor owner

Assumptions : economic life of tractor 5 years; salvage value 10%; interest 12% per year

(Rp '000)

Season	K	C	B	DF 6%[a]	PVC	PVB	DF 10%[b]	PVC	PVB
0	1,300			1	1,300		1	1,300	
1		164	356	.943	155	336	.909	149	324
2		164	356	.890	146	317	.826	136	294
3		164	356	.840	138	299	.751	123	268
4		164	356	.792	130	282	.683	112	243
5		164	356	.747	123	266	.621	102	221
6		164	356	.705	116	251	.564	93	201
7		164	356	.665	109	237	.513	84	183
8		164	356	.627	103	223	.467	77	166
9		164	356	.591	97	211	.424	70	151
10		164	486	.558	92	271	.386	63	188
					2,509	2,693		2,309	2,239

Notes : Numbers for calculation are rounded in thousands

a) As calculation is based on seasonal basis, the discount rate used is 6% instead of 12%

b) Discount factor 10% only use for calculating IRR

Results : 1) NPV = Rp 2,693,000 - Rp 2,509,000 = Rp 184,000

2) B/C = Rp 2,693,000 / Rp 2,509,000 = 1.07

3) IRR = (.06 + 184 x .04/254) x 2 = 17.8%

Appendix 3.5. : Financial cost-benefit analysis from the view point of tractor owner

Assumptions : economic life of tractor 3 years; salvage value 46%; interest 12% per year

(Rp '000)

Season	K	C	B	DF 6%[a]	PVC	PVB	DF 10%[b]	PVC	PVB
0	1,300			1	1,300		1	1,300	
1		164	372	.943	155	351	.909	149	338
2		164	372	.890	146	331	.826	136	307
3		164	372	.840	138	312	.751	123	279
4		164	372	.792	130	295	.683	112	254
5		164	372	.747	123	278	.621	102	231
6		164	970	.705	116	684	.564	93	547
					2,108	2,251		2,015	1,956

Notes : Numbers for calculation are rounded in thousands

a) As calculation is based on seasonal basis, thae discount rate use is 6% instead of 12%

b) Discount factor 10% only use for calculating IRR

Results : 1) NPV = Rp 2,251,000 - Rp 2,108,000 = Rp 143,000

2) B/C = Rp 2,251,000 / Rp 2,108,000 = 1.07

3) IRR (.06 + 143 x .04/202) x 2 = 17.6%

Appendix 3.6. : Financial cost-benefit analysis based on the proposal of the hand-tractor leasing project

Assumptions : economic life of tractor 3 years; salvage value 10%; interest 12% per year

(Rp '000)

Season	K	C	B	DF 6%[a]	PVC	PVB	DF 20%[b]	PVC	PVB	DF 25%[b]	PVC	PVB
0	1,212			1	1,212		1	1,212		1	1.212	
1		395	791	.943	373	746	.833	329	659	.800	316	633
2		395	791	.890	352	704	.694	274	549	.640	253	506
3		395	791	.840	332	664	.579	229	458	.512	202	405
4		395	791	.792	313	626	.482	190	381	.410	162	324
5		395	791	.747	295	591	.401	158	317	.328	130	259
6		395	912	.705	279	643	.335	132	306	.262	103	239
					3,156	3,974		2,525	2,670		2,378	2,366

Notes : Numbers for calculation are rounded in thousands

a) As calculation is based on seasonal basis, the discount rate use is 6% instead of 12%

b) Discount factor 20 and 25 percent only used for calculating IRR

Results : 1) NPV = Rp 3,974,000 - Rp 3,156,000 = Rp 818,000

2) B/C = Rp 3,974,000 / Rp 3,156,000 = 1.26

3) IRR = (.20 + 145 x .05/157) x 2 = 49%

Appendix 3.7. : Financial cost-benefit analysis based on the proposal of the leasing hand-tractor project

Assumptions : economic life of tractor 5 years; salvage value 10%; area cultivated per season 18 ha; i = 12%/year

(Rp '000)

Season	K	C	B	DF 6%[a]	PVC	PVB	DF 10%[b]	PVC	PVB
0	1,212			1	1,212		1	1,212	
1		178	356	.943	168	336	.909	162	323
2		178	356	.890	158	317	.826	147	294
3		178	356	.840	149	299	.751	134	267
4		178	356	.792	141	282	.683	121	243
5		178	356	.747	133	266	.621	110	221
6		178	356	.705	125	251	.564	100	201
7		178	356	.665	118	237	.513	91	183
8		178	356	.627	112	223	.467	83	166
9		178	356	.591	105	210	.424	75	151
10		178	477	.558	99	266	.386	69	184
					2,520	2,687		2,304	2,233

Notes : Numbers for calculation are rounded in thousands

a) As calculation is on seasonal basis, the discount rate used is 6% instead of 12%

b) Discount factor 10 percent only used for calculating IRR

Results : 1) NPV = Rp 2,687,000 - Rp 2,520,000 = Rp 167,000

2) B/C = Rp 2,687,000 / Rp 2,520,000 = 1.07

3) IRR = (.06 + 167 x .04/238) x 2 = 17.6%

Appendix 3.8. : Price of tractor at various import tax, before and after devaluation.

I. Before devaluation : US$ 1 = Rp 415

a. Import tax : 20% cif (see appendix 3.3.)

b. Import tax : 50% cif

Devisa c&f		= Rp 625,650
Insurance : 0.5% c&f		= Rp 3,128
	CIF price	= Rp 628,778
Import tax : 50% cif	= Rp 314,389	
MPO import : Rp 38/us$ 1	= Rp 57,288	
Warehouse : 15% c&f	= Rp 93,848	
Sale tax : 10% cif	= Rp 62,878	
Other costs: 1.2% cif	= Rp 7,508	
		= Rp 535,911
	Sub-total	= Rp 1,164,689
Agent commission : 5% cif		= Rp 31,439
	Sub-total	= Rp 1,196,128
Importer (sole distributor) profit : 15%		= 119,613
	Sub-total	= Rp 1,315,741
Sale tax ; 5%		= Rp 65,787
	Price in Jakarta	= Rp 1,381,528
	Transportation cost	= Rp 82,623
	Price in Bali	= Rp 1,464,151

c. Import tax : 75% cif

CIF price of tractor		= Rp 628,778
Import tax : 75% cif	= Rp 471,584	
Other costs[1)]	= Rp 252,961	
		= Rp 724,545
	Sub-total	= Rp 1,353,323
Impoter (sole distributor) profit : 15%		= Rp 202,998
	Sub-total	= Rp 1,556,321

(to be continued)

	Sub-total	= Rp 1,556,321
Sale tax ; 5%		= Rp 77,816
	Price in Jakarta	= Rp 1,634,137
	Transportation cost	= Rp 82,623
	Price in Bali	= Rp 1,716,760

d. Import tax : 100% cif

CIF price		= Rp 628,778
Import tax : 100% cif	= Rp 628,778	
Other costs[1)]	= Rp 252,961	
		= Rp 881,739
	Sub-total	= Rp 1,510,517
Importer (sole distributor) profit : 15%		= Rp 226,578
	Sub-total	= Rp 1,737,095
Sale taxe : 5%		= Rp 86,855
	Price in Jakarta	= Rp 1,823,950
	Transportation cost	= Rp 82,623
	Price in Bali	= Rp 1,906,573

Note : 1) Other costs include : MPO import
warehouse
sale tax .
agent commission, and
others.

II. After devaluation : US$ 1 = Rp 625

a. Import tax : 20%

Devisa c&f : US$ 1,507.59 x Rp 625		= Rp 942,244
Insurance : 0.5% c&f		= Rp 4,711
CIF price		= Rp 946,955
Import tax : 20% cif	= Rp 189,391	
Other costs	= Rp 351,975	
		= Rp 541,366
Sub-total		= Rp1,488,321
Importer (sole distributor) profit : 15%		= Rp 223,248
Sub-total		= Rp1,711,569
Sale tax : 5%		= Rp 85,578
Price in Jakarta		= Rp 1,797,147
Transportation cost		= Rp 82,623
Price in Bali		= Rp 1,879,770

b. Import tax : 50%

CIF price		= Rp 946,955
Import tax : 50% cif	= Rp 473,478	
Other costs	= Rp 351,975	
		= Rp 825,453
Sub-total		= Rp 1,772,408
Impoter (sole distributor) profit : 15%		= Rp 265,861
Sub-total		= Rp 2,038,269
Sale tax ; 5%		= Rp 101,913
Price in Jakarta		= Rp 2,140,182
Transportation cost		= Rp 82,623
Price in Bali		= Rp 2,222,805

c. Import tax : 75% cif

CIF price		= Rp 946,955
Import tax : 75%cif	= Rp 710,216	
Other costs	= Rp 351,975	
	---	= Rp 1,062,191
	Sub-total	= Rp 2,009,146
Importer (sole distributor) profit : 15%		= Rp 301,372
	Sub-total	= Rp 2,310,518
Sale tax : 5%		= Rp 115,526
	Price in Jakarta	= Rp 2,426,044
	Transportation cost	= Rp 82,623
	Price in Bali	= Rp 2,508,667

d. Import tax : 100% cif

CIF price		= Rp 946,955
Import tax : 100% cif	= Rp 946,955	
Other costs	= Rp 351,975	
	---	= Rp 1,294,219
	Sub-total	= Rp 2,241,174
Importer (sole distributor) profit : 15%		= Rp 336,176
	Sub-total	= Rp 2,577,350
Sale tax : 5%		= Rp 128,868
	Price in Jakarta	= Rp 2,706,218
	Transportation cost	= Rp 82,623
	Price in Bali	= Rp 2,788,841

Appendix 4.1. : Shadow price of tractor (1976/77)

C & F price of tractor		= US$ 1,507.59
Insurance : 0.5%		= 7.54
	CIF price	= US$ 1,515.13
Cost :		
1. Cable 0.1% c&f	= US$ 1.51	
2. Bank 0.5% c&f	= 7.54	
3. Document provision 0.5%c&f	7.54	
4. Agent commission 5% cif	= 75.76	
Total costs		= US$ 92.35
Sub-total		= US$ 1,607.48
5. Importer (sole distributor) profit : 15%		= 241.12
Shadow price in Jakarta		= US$ 1,848.60

a. Using shadow price of foreign exchange US$ 1 = Rp 415

Price of tractor in Jakarta	= Rp 767,169
Transportation cost	= Rp 82,623
Shadow price of tractor in Bali	= Rp 849,792

b. Using shadow price of foreign exchange US$ 1 = Rp 625

Price of tractor in Jakarta	= Rp 1,155,375
Transportation cost	= Rp 82,623
Shadow price of tractor in Bali	= Rp 1,237,998

Note : Calculation is based on the information of PT Indokaya Jakarta, 28/3/80

Appendix 4.2. : Shadow price of fuel

CIF price of fuel diesel at port of Tanjung Priok :
US$ 63,023,936 for 621,358 kl = US$ 0.101 per liter
(Source: CBS, Indonesian Import According Country of Origin 1977)

a. Using shadow price of foreign exchange US$ 1 = Rp 415
   Shadow price of fuel per liter = Rp 42
   Fuel consumption of tractor per hectare = 25 lt
   Fuel cost per hectare = 25 lt x Rp 42 = Rp 1,050

b. Using shadow price of foreign exchange US$ 1 = Rp 625
   Shadow price of fuel per liter = Rp 63
   Fuel consumption of tractor per hectare = 25 lt
   Fuel cost per hectare = 25 lt x Rp 63 = Rp 1,575

Appendix 4.3. : Shadow price of lubricating oil

CIF price of lubricating oil at port of Tanjung Priok
US$ 23,207,857 for 57,021 kl = US$ 0.41 per liter
(Source : CBS, ibid)

a. Using shadow price of foreign exchange US$ 1 = Rp 415
   Shadow price of lubricating oil per liter = Rp 170
   Oil consumption per hectare = 1.6 liter
   Oil cost per hectare = 1.6 lt x Rp 170 = Rp 272

b. Using shadow price of foreign exchange US$ 1 = Rp 625
   Shadow price of lubricating oil per liter = Rp 256
   Oil consumption per hectare = 1.6 liter
   Oil cost per hectare = 1.6 lt x Rp 256 = Rp 410

Appendix 4.4. : Shadow price of maintanance cost of tractor

$$\text{Maintenance cost per hour} = \left(\frac{1.2\%}{100} \times \text{Price of tractor}\right)$$

Capacity tractor per hectare = 20 hours

Maintenance cost per hecatre =

$$\left(\frac{1.2\%}{100} \times \text{Price of tractor}\right) \times 20 \text{ hours}$$

a. Using shadow price of foreign exchange US$ 1 = Rp 415

Shadow price of tractor (in Bali) = Rp 851,187

$$\text{Maintenance cost/ha} = \left(\frac{1.2\%}{100} \times \text{Rp } 849{,}792\right) \times 20 = \text{Rp } 2{,}038$$

b. Using shadow price of foreign exchange US$ 1 = Rp 625

Shadow price of tractor (in Bali) = Rp 1,237,998

$$\text{Maintenance cost/ha} = \left(\frac{1.2\%}{100} \times \text{Rp } 1{,}237{,}998\right) \times 20 = \text{Rp } 2{,}971$$

Appendix 4.5. : Shadow price of benefit

Assumptions :

1. Introducing hand-tractor for land preparation increasing cropping intensity by 20%
2. Average yield (HYV) per hectare = 4 ton rough rice
3. Conversion rate (rendement) of rough rice into milled rice is 60%

Hence, an increase in production as a result of introducing hand-tractor for land preparation is 20% x 4 ton of rough rice = 0.8 ton of rough rice per year, this equal to : 60% x 0.8ton = 0.48 ton of milled rice per year or 0.24 ton of milled rice per season.

Price of rice (fob) at port Bangkok	= US$ 250 per ton
Freight and insurance 15%	= US$ 37.5
CIF price of rice	= US$ 287.5 per ton

(source : Far Eastern Economic Review,1977)

a. Using shadow price of foreign exchange US$ 1 = Rp 415

World price of rice (medium quality) :
US$ 287.5 x Rp 415 = Rp 119,312.5 per ton

The price of HYV rice (low quality) : 80% x Rp 119,312.5
= Rp 95,450 per ton

Shadow price of benefit per season :
0.24 ton x Rp 95,450 = Rp 22,908

b. Using shadow price of foreign exchange US$ 1 = Rp 625

World price of rice (medium quality) :
US$ 287.5 x Rp 625 = Rp 179,687.5 per ton

The price of HYV rice (low quality) :
80% x Rp 179,687.5 = Rp 143,750 per ton

Shadow price of benefit per season :
0.24 ton x Rp 143,750 = Rp 34,500

Appendix 4.6. : Economic Analysis from the point of view of the society
Assumptions : economic life of tractor 5 years, salvage value 10%; i = 12%/year; ICI = 20%
Shadow price of foreign exchange US$ 1 = Rp415
(Rp '000)

Season	K	C	B	DF 6%[a]	PVC	PVB	DF 25%[b]	PVC	PVB	DF 30%[b]	PVC	PVB
0	850			1	850		1	850		1	850	
1		144	412	.943	136	389	.800	115	330	.769	111	317
2		144	412	.890	128	367	.640	92	264	.592	85	244
3		144	412	.840	121	346	.512	74	211	.455	66	187
4		144	412	.792	114	326	.410	59	169	.350	50	144
5		144	412	.747	108	308	.326	47	134	.269	39	111
6		144	412	.705	102	290	.262	38	108	.207	30	85
7		144	412	.665	96	274	.210	30	87	.159	23	66
8		144	412	.627	90	258	.168	24	69	.123	18	51
9		144	412	.592	85	244	.134	19	55	.094	14	39
10		144	497	.558	80	277	.107	15	53	.073	11	36
					1,910	3,079		1,363	1,480		1,297	1,280

Notes : Number for calculation are rounded in thousandes

a) As calculation is on seasonal basis, the discount rate used is 6% insted of 12%

b) Discount factor 25 and 30 percent only used for calculating IRR

Results : NPV = Rp 3,079,000 - Rp 1,910,000 = Rp 1,169,000

B/C = Rp 3,079,000 / Rp 1,910,000 = 1.6

IRR = (.25 + .05 x 117/134) x 2 = 59%

Appendix 4.7. : Economic Analysis from the point of view of the society
Assumptions : economic life of tractor 5 years; salvage value 10%; i = 12%/year; ICI = 20%
Shadow price of foreign exchange US$ 1 = Rp 625
(Rp '000)

Season	K	C	B	DF 6% a)	PVC	PVB	DF 30% b)	PVC	PVB	DF 35% b)	PVC	PVB
0	1,238			1	1,238		1	1,238		1	1,238	
1		172	621	.943	162	586	.769	132	478	.741	127	460
2		172	621	.890	153	553	.592	102	368	.549	94	341
3		172	621	.840	144	522	.455	78	283	.406	70	252
4		172	621	.792	136	492	.350	60	217	.301	52	187
5		172	621	.747	128	464	.269	46	167	.223	38	138
6		172	621	.705	121	438	.207	36	129	.165	28	102
7		172	621	.665	114	413	.159	27	99	.122	21	76
8		172	621	.627	108	389	.123	21	76	.090	15	56
9		172	621	.592	102	368	.094	16	58	.067	12	42
10		172	745	.558	96	416	.073	13	54	.050	9	37
					2,504	4,639		1,770	1,929		1,705	1,692

Notes : Number for calculation are rounded in thousands; i = interest; ICI = Increase in cropping intensity

a) As calculation is based on seasonal basis, the discount rate used is 6% instead 0f 12%

Results : 1) NPV = Rp 4,639,000 - Rp 2,504,000 = Rp 2,135,000

2) B/C = Rp 4,639,000 / Rp 2,504,000 = 1.85

3) IRR = (.30 + .05 x 159/172) x 2 = 69%

Note b) Discount factor 30 and 35 percent only used for calculating IRR

Appendix 4.8. : Economic analysis from the point of view of the society
Assumptions : economic life of tractor 5 years; salvage value 10%; i = 12%/year; ICI = 14%
Shadow price of foreign exchange US$ 1 = Rp 415

(Rp '000)

Season	K	C	B	DF 6%[a)]	PVC	PVB	DF 10%[b)]	PVC	PVB	DF 13%[b)]	PVC	PVB
0	850			1	850		1	850		1	850	
1		144	289	.943	136	273	.909	131	263	.885	127	256
2		144	289	.890	128	257	.826	119	239	.783	113	226
3		144	289	.840	121	243	.751	108	217	.693	100	200
4		144	289	.792	114	229	.683	98	197	.613	88	177
5		144	289	.747	108	216	.621	89	179	.543	78	157
6		144	289	.705	102	204	.564	81	163	.480	69	139
7		144	289	.665	96	192	.513	74	148	.425	61	123
8		144	289	.627	90	181	.467	67	135	.376	54	109
9		144	289	.592	85	171	.424	61	123	.333	48	96
10		144	1 374	.558	80	209	.386	56	144	.295	42	110
					1,910	2,174		1,735	1,808		1,631	1,593

Notes : Numbers for calculation are rounded in thousands; i = interest; ICI = increase in cropping intensity

a) As calculation is on seasonal basis, the discount rate used is 6% instead of 12%

b) Discount factor 10 and 13 percent only used for calculating IRR

Results : 1) NPV = Rp 2,174,000 - Rp 1,910,000 = Rp 264,000

2) B/C = Rp 2,174,000 / Rp 1,910,000 = 1.14

3) IRR = (.10 + .03 x 73/111) x 2 = 24%

Appendix 4.9. : Economic analysis from the point of view of the society
Assumptions : economic life of tractor 5 years; salvage value 10%; i = 12%/year; ICI = 13%
Shadow price of foreign exchange US$ 1 = Rp 415

(Rp '000)

Season	K	C	B	DF 6%[a]	PVC	PVB	DF 8%[b]	PVC	PVB	DF 12%[b]	PVC	PVB
0	850			1	850		1	850		1	850	
1		144	268	.943	136	253	.926	133	248	.893	129	239
2		144	268	.890	128	239	.857	123	300	.797	115	214
3		144	268	.840	121	225	.794	114	213	.712	103	191
4		144	268	.792	114	212	.735	106	197	.636	92	170
5		144	268	.747	108	200	.681	98	183	.567	82	152
6		144	268	.705	102	190	.630	91	169	.507	73	136
7		144	268	.665	96	178	.583	84	156	.452	65	121
8		144	268	.627	90	168	.540	78	145	.404	58	108
9		144	268	.592	85	159	.500	72	134	.361	52	97
10		144	353	.558	80	197	.463	67	163	.322	46	114
					1,910	2,020		1,816	1,837		1,664	1,542

Notes : Numbers for calculation are rounded in thousands; i = interest; ICI = increase in cropping intensity

a) As calculation is on seasonal basis, the discount rate used is 6% instead of 12%

b) Discount factor 8 and 12 percent only used for calculating IRR

Results : 1) NPV = Rp 2,020,000 - Rp 1,910,000 = Rp 110,000

2) B/C = Rp 2,020,000 / Rp 1,910,000 = 1.06

3) IRR = (.08 + .04 x 21/143) x 2 = 16%

Appendix 4.10. : Economic analysis from the point of view of the society
Assumptions : economic life of tractor 5 years; salvage value 10%; i = 12%/year; ICI = 12%
Shadow price of foreign exchange US$ 1 = Rp 415

(Rp '000)

Season	K	C	B	DF 6%[a]	PVC	PVB	DF 2%[b]	PVC	PVB
0	850			1	850		1	850	
1		144	247	.943	136	233	.980	141	242
2		144	247	.890	128	220	.961	138	237
3		144	247	.840	121	207	.942	136	233
4		144	247	.792	114	196	.924	133	228
5		144	247	.747	108	185	.906	130	224
6		144	247	.705	102	174	.888	128	219
7		144	247	.665	96	164	.871	125	215
8		144	247	.627	90	155	.853	123	211
9		144	247	.592	85	146	.836	120	206
10		144	332	.558	80	185	.820	118	272
					1,910	1,865		2,143	2,288

Notes : Numbers for calculation are rounded in thousands; i = interest; ICI = increase cropping intensity.

a) As calculation is on seasonal basis, the discount rate used is 6% instead of 12%

Results : 1) NPV = Rp 1,865,000 - Rp 1,910,000 = -Rp45,000

2) B/C = Rp 1,865,000 / Rp 1,910,000 = 0.98

3) IRR = (.02 + .04 x145/190 x 2 = 10%

Appendix 4.11. : Economic analysis from the point of view of the society
Assumptions : economic life of tractor 5 years; salvage value 10%; i = 12%/year; ICI = 14%
Shadow price of foreign exchange US$ 1 = Rp 625

(Rp '000)

Season	K	C	B	DF 6%[a]	PVC	PVB	DF 15%[b]	PVC	PVB	DF 20%[b]	PVC	PVB
0	1,238			1	1,238		1	1,238		1	1,238	
1		172	435	.943	162	410	.870	150	378	.833	143	362
2		172	435	.890	153	387	.756	130	329	.694	119	302
3		172	435	.840	144	365	.658	113	286	.579	100	252
4		172	435	.792	136	345	.572	98	249	.482	83	210
5		172	435	.747	128	325	.497	85	216	.402	69	175
6		172	435	.705	121	307	.432	74	188	.335	58	146
7		172	435	.665	114	289	.376	65	164	.279	48	121
8		172	435	.627	108	273	.327	56	142	.233	40	101
9		172	435	.592	102	258	.284	49	124	.194	33	84
10		172	559	.558	96	312	.247	42	138	.162	28	91
					2,504	3,270		2,102	2,214		1,959	1,844

Notes : Numbers for calculation are rounded in thousands; i = interest; ICI = increase in cropping intensity
a) As calculation is on seasonal basis, the discount rate used is 6% instead of 12%
b) Discount factor 15 and 20 percent only used for calculating IRR

Results : 1) NPV = Rp 3,270,000 - Rp 2,504,000 = Rp 766,000
2) B/C = Rp 3,270,000 / Rp 2,504,000 = 1.3
3) IRR = (.15 + .05 x 112/227) x 2 = 35%

Appendix 4.12. : Economic analysis from the point of view of the society
Assumptions : economic life of tractor 5 years; salvage value 10%; i = 12%/year; ICI 13%
Shadow price of foreign exchange US$ 1 = Rp 625

(Rp '000)

Season	K	C	B	DF 6%[a]	PVC	PVB	DF 10%[b]	PVC	PVB	DF 15%[b]	PVC	PVB
0	1,238			1	1,238		1	1,238		1	1,238	
1		172	404	.943	162	381	.909	156	367	.870	150	351
2		172	404	.890	153	360	.826	142	334	.756	130	305
3		172	404	.840	144	339	.751	129	303	.658	113	266
4		172	404	.792	136	320	.683	117	276	.572	98	231
5		172	404	.747	128	302	.621	107	251	.497	85	201
6		172	404	.705	121	285	.564	97	228	.432	74	175
7		172	404	.665	114	269	.513	88	207	.376	65	152
8		172	404	.627	108	253	.467	80	189	.327	56	132
9		172	404	.592	102	239	.424	73	171	.284	49	115
10		172	528	.558	96	295	.386	66	204	.247	42	130
					2,504	3,042		2,295	2,530		2,102	2,058

Notes : Numbers for calculation are rounded in thousands; i = interest; ICI = increase in cropping intensity

a) As calculation is on seasonal basis, discount rate used is 6% insted of 12%

b) Discount factor 10 lnd 15 percent only used for calculating IRR

Results : 1) NPV = Rp 3,042,000 - Rp 2,504,000 = Rp 538,000

2) B/C = Rp 3,042,000 / Rp 2,504,000 = 1.2

3) IRR = (.10 + .05 x 235/275) x 2 = 29%

Appendix 4.13.: Economic analysis from the point of view of the society
Assumptions : economic life of tractor 5 years;salvage 10%; i = 12%/year; ICI = 12%
Shadow price of foreign exchange US$ 1 = Rp 625
(Rp '000)

Season	K	C	B	DF 6%[a]	PVC	PVB	DF 8%[b]	PVC	PVB	DF12%[b]	PVC	PVB
0	1,238			1	1,238		1	1,238		1	1,238	
1		172	373	.943	162	352	.926	159	345	.893	154	333
2		172	373	.890	153	332	.857	147	320	.797	137	297
3		172	373	.840	144	313	.794	137	296	.712	122	266
4		172	373	.792	136	295	.735	126	274	.636	109	237
5		172	373	.747	128	279	.681	117	254	.567	98	211
6		172	373	.705	121	263	.630	108	235	.507	87	189
7		172	373	.665	114	248	.583	100	217	.452	78	169
8		172	373	.627	108	234	.540	93	201	.404	69	151
9		172	373	.592	102	221	.500	86	187	.361	62	135
10		172	497	.558	96	277	.463	80	230	.322	55	160
					2,504	2,814		2,392	2,560		2,210	2,148

Notes : Numbers for calculation are rounded in thousands; i = interest; ICI = increase in cropping intensity

a) As calculation is on seasonal basis, discount rate used is 6% instead Of 12%

b) Discount factor 8 and 12 percent only used for calculating IRR

Results : 1) NPV = Rp 2,814,000 - Rp 2,504,000 = Rp 310,000

2) B/C = Rp 2,814,000 / Rp 2,504,000 = 1.12

3) IRR = (.08 + .04 x 168/230) x 2 = 22%

Appendix 4.14. : Economic analysis from the point of view of the society

Assumptions : economic life of tractor 5 years; salvage value 10%; i = 12%/year; ICI = 11%
Shadow price of foreign exchange US$ 1 = Rp 625
(Rp '000)

Season	K	C	B	DF 6%[a]	PVC	PVB	DF 10%[b]	PVC	PVB
0	1,238			1	1,238		1	1,238	
1		172	342	.943	162	323	.909	156	311
2		172	342	.890	153	304	.826	142	282
3		172	342	.840	144	287	.751	129	257
4		172	342	.792	136	271	.683	117	234
5		172	342	.747	128	255	.621	107	212
6		172	342	.705	121	241	.564	97	193
7		172	342	.665	114	227	.513	88	175
8		172	342	.627	108	214	.467	80	160
9		172	342	.592	102	202	.434	73	148
10		172	466	.558	96	260	.386	66	180
					2,504	2,586		2,295	2,153

Notes : Numbers for calculation are rounded in thousands; i = interest; ICI = Increase cropping intensity

a) As calculation is on seasonal basis, discount rate used is 6% instead of 12%

b) Discount factor 10 percent only used for calculating IRR

Results : 1) NPV = Rp 2,586,000 - Rp 2,504,000 = Rp 82,000

2) B/C = Rp 2,586,000 / Rp 2,504,000 = 1.03

3) IRR = (.06 + .04 x 82/224) x 2 = 15%

Appendix 4.15. : Economic analysis from the point of view of the society
Assumptions : economic life of tractor 5 years;salvage value 10%; i = 12%/year;ICI = 10%
Shadow price of foreign exchange US$ 1 = Rp 625

(Rp '000)

Season	K	C	B	DF 6% a)	PVC	PVB	DF 2% b)	PVC	PVB
0	1,238			1	1,238		1	1,238	
1		172	311	.943	162	293	.980	169	305
2		172	311	.890	153	277	.961	165	299
3		172	311	.840	144	261	.942	162	293
4		172	311	.792	136	246	.924	159	287
5		172	311	.747	128	232	.906	156	282
6		172	311	.705	121	219	.888	153	276
7		172	311	.665	114	207	.871	150	271
8		172	311	.627	108	195	.853	147	265
9		172	311	.592	102	184	.837	144	260
10		172	435	.558	96	243	.820	141	357
					2,504	2,358		2,783	2,895

Notes : Numbers for calculation are rounded in thousands; i = interest; ICI = increase in cropping intensity

a) As calculation is on seasonal basis, discount rate used is 6% instead of 12%

b) Discount factor 2 percent only used for calcualting IRR

Results : NPV = Rp 2,358,000 - Rp 2,504,000 = -Rp 146,000

B/C = Rp 2,358,000 / Rp 2,504,000 = 0.94

IRR = (.02 + .04 x 112/258) x 2 = 7%